Master's Degree Thesis

LOG950 Logistics

Title **Public Transport-Based Crowd Shipping for Sustainable City Logistics: Assessing Economic and Environmental Impacts - A Case Study of the City of London**

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Preface

This thesis was conducted in fulfilment of the requirement for Master of Science in Supply Chain Management and Master of Science in Petroleum Logistics at the Faculty of Logistics at Molde University College. The research was carried out from December 2019 to May 2020.

First and foremost, we express our sincerest gratitude to God for seeing us through the entire duration of our master's education. Furthermore, we extend our appreciation to the invaluable Edoardo Marcucci and Valerio Gatta who mentored and supervised our research.

Again, we appreciate all our professors, lecturers, colleagues and mates who contributed to our education. Lastly, to our parents, families, loved ones and friends for their relentless support throughout our studies.

Summary

By and large, urbanisation is a complementing factor of advancement and globalisation. The United Nation's Department of Economic and Social Affairs, reports that several rural areas and major urban areas will experience a growth rate in by the year 2030.
Nevertheless, the inevitable downside of it all, is the traffic, congestion, environmental degradation and the cost that is associated with it.

The purpose of this thesis was to find and suggest a logistical remedy to control the adverse factors in the urban transportation sector, specifically with product delivery. Furthermore, we sought to ascertain the economic implications of the implementation of crowd-shipping, along with the theory of its impact on the environment. That is, the willingness to act and the willingness to patronize the service

To fulfil the purpose of this thesis, quantitative data was collected from a total of 84 respondents and analyzed using SPSS and JMP software. Using the Stated Preference and Discrete choice model, we considered London, one of Europe's densely populated economic zones with the best functional metro systems as the setting.

The results of the research illustrated that respondents were keen on acting as crowd-shippers as well as utilizing the novel logistics service. We also found out; respondents were confident of the success of the service in urban areas with majority projecting a success rate of 75% to 90%. Additionally, from the demand side, of our attributes, we realised the most integral factor that influenced the decision to utilise the crowds-shipping service is the ability to track the delivery. Followed by shipping time, shipping cost and the possibility to plan delivery, respectively. On the supply side; location of lockers was the most salient followed by pick-up arrangement, remuneration and bank credit mode, respectively. We concluded on the theory that crowd-shipping is a cost-beneficial and sustainable logistic service for urban areas and would aid retailer, e-commerce and other stakeholders.

Key Words: Crowd-shipping, Discrete Choice Model, Urbanisation, City Logistics, sustainability

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Chapter 1

1.0 Introduction

This chapter highlights the relationship and characters in a city logistics model. The section provides knowledge on the subject by elucidating, the problems, challenges and possibilities associated with a specific aspect of sharing economy, precisely that of the delivery of goods. In this chapter, a summary of the application of the thesis concerning the City of London will be given. Hence, presenting the reader with a clear idea of what the research entails.

1.1 Cities and Traffic

Urbanisation has gained popularity in recent times with majority of people recorded to be living in the urban areas, compared to rural areas. A report from World Urbanization Perspectives Report (UN, 2014) states that more than 54 per cent of the world's population reside in cities with a projected growth of about 12 percent more by 2050. In this vein, a vast demand in variation of movement and transportation options are required. Urban mobility has a definite influence on the environment, with 40 percent of carbon dioxide emissions in Europe accounted for by road transport (European Commission, 2015).

Furthermore, another factor that stands paramount is road congestion and the rise of e-commerce; research and innovative has been promoted by the European Commission to develop policy interventions in the urban freight transport world (Lozzi et al,2018). A struggle to fairly balance the positive impacts on availability, accessibility and economic development and negative externalities in terms of congestion and environmental pollution (emissions), (Ranieri et al, 2018) Also, sustainability has gained traction among administrations and authorities with an increased concern in ways urban logistics can meet its objectives (Anderson, Allen and Browne, 2005)

Additionally, the transport industry is predominantly constituted by digitalization and technological revolution that gives prevalence to novel concepts of shipping. Envisioning new technologies and strategies is one of the critical elements to enhance performance and to reduce the adverse impacts of the delivery of goods (Macharis and Kin 2017). In that regard, Savelsbergh and Van Woensel (2016) define crowd-logistics as one of the emerging models of

innovation; thus, it is relevant to approach the operating model, ventures, legal and behavioural problems associated.

1.2 Crowd-shipping: Potential and Challenges

This thesis provides an investigation into the delivery of goods by crowd, a system called "border" (Wang et al., 2016) and "revolutionary change in distribution in the city" (Macharis and Kin 2017). According to (Sancha et al., 2016; Stindt et al., 2016) sustainable supply chain model is a set of supply chain ambitions intending at enhancing the social condition of distinct fragments of the supply chain while heightening resource-efficiency, innovation, credibility including the market share and decreasing negative environmental impact.

However, with the increasing growth in demand for logistics services in the urban areas, the aim to implement sustainability has proved rather futile. Nonetheless, the implementation of crowd shipping services may salvage the situation. Crowd-shipping may be defined *as "a freight delivery service that is entrusted to occasional carriers, taken from the audience, which is coordinated by a technical platform to get benefits for all involved."* Crowd-shipping offers the opportunity of using private motorized operators to perform logistics activities. According to (Bubner et al., 2014), the introduction of novel and innovative transportation options such as crowd shipping may go a long way to reduce transportation cost and emissions due to the unutilized transport capacity; therefore, satisfying the growing economics and environmental concerns.

The study of crowd shipping is challenging since it lacks operational evenness, requires real organised systems that disperse operational data and is relatively new. Crowd shipping is perceived as an innovative idea and a remedy that can be adapted in the last mile of generic transport in online retail or as a connection between a retailer (Habner, Kuhn and Wollenburg, 2015; Slabinac, 2015; Chen and Pan, 2015).

The principal advantages in Crowd shipping involve various stakeholders; Potential carriers can earn an income from the delivery service. On the other hand, senders benefit from value-added elements such as tracking, transparency, and tailor-made delivery, and affordable cost. (Miller et al., 2017). Also, for service companies, the benefit of crowd shipping is reduced operating costs as compared to the generic logistics operators, and this as a result of increased flexibility (Rouges and Montreuil 2014).

Furthermore, from a more extensive scope, the model has the potential to reduce traffic with its environmental repercussions, particularly for last-mile deliveries (McKinnon et al., 2015).
A significant number of deliveries are performed were handled by couriers via city routes causing adverse conditions such as pollution and congestion. The inception of crowd shipping systems would better adjust the movement of vehicles in urban areas since a systematic delivery approach would be employed to reduce the number of delivery vehicles (ATKearney, 2015),
Nonetheless, some constraints are associated with the service, matters relating to trust and responsibility (Rouges and Montreuil, 2014). Crowd logistics is also a novel service; thus, management can be significantly daunting to apply and limited by legal obstacles (Habner, Kuhn and Wollenburg, 2015).

1.3 Research Purpose and Boundaries

The purpose of this thesis is to study the acceptance of crowd-shipping and to propose a feasibility analysis in an application case.
Specifically, the thesis focuses on crowd-shipping based on the Business to customer trade using public transport, as a means of transport, and the Automated Parcel Locker.

The objectives are to know the willingness to pay for crowd shipping (demand) and willingness to act as crowd shippers (supply) based on the utility, they derive from preferred attributes. The use of boundaries is, however, necessary to narrow down the scope of the investigation, and, as stated by Collis and Hussey (2014), establishes the scope of the research. First, research is focused on transport within the urban area of London to limit this study on the last mile of delivery.

The analysis focuses on a specific branch of commerce, namely business to customer (B2C). Although it represents only a part of the urban transport of goods, this sector is suitable for crowd-shipping for future developments (Gatta et al. 2019). Most of the goods transported are of reasonable size and weight which make them transportable by the "crowd" on their usual journeys (e.g. commuting, shopping, etc.).

The city of London was found suitable for this study due to several reasons: high territorial extension, presence of a metro network, cosmopolitan nature, high density of housing and high

traffic (Imrie et al, 2019). This implies that some of the results of this thesis are particularly related to this context. However, this does not mean that the results could not be interesting and relevant to other cities experiencing similar problems.

1.4 Research Problem

On the backdrop of existing research and literature, this study seeks to answer the following questions:

- Under what conditions are people willing to act as crowd shippers?
- What is the demand for crowd shipping services and crowd shippers?

1.5 Significance of the Study

Crowd shipping is a growing phenomenon in public transport and seems to take transportation to a different tangent. We are assessing the impact of the economy or the financial effect of the implementation of crowd shipping coupled with its impact on global and very relevant topic the environment, Combing the economic and environmental effect of crowd shipping makes this topic more intriguing and relevant to Logistics and other disciplines. Also, the result of this study will aid understand and quantify future strategy for last-mile Business to Customer deliveries. Moreover, it provides local law makers the information to develop the public transport crowd shipping and determining the economic and environmental impacts.

1.6 Scope

Ordinarily, throughout this thesis, the term London is used for homogeneity; However, modern-day London is known as Greater London. The City of London is significantly smaller with 1.12 square miles (2.9 square kilometres) just over a square mile with about 10,000 inhabitants, although over 300,000 people travel there for work. (World Population Review, 2020)

Currently, London's population is estimated at 9,304,016 growth with a growth rate of 1.39% is anticipated to touch the 10 million mark by 2030 and shall join the current group of ten capital cities with 10 million inhabitants or more.

London is and the 27th most populated metro area in the world, and the third largest city in Europe, after Moscow (10.3 million) and Istanbul (14.8 million) (United Nations, 2019).

This data has led the various departments to deal with research to regulate better traffic in the perspective of all the actors involved, thus making London a perfect setting for study and experimentation. Considering London's mobility issues, the city seems to be a suitable place to study the possible impact of crowd freight delivery in a city logistics model innovative since it is highly cosmopolitan and popularly dense.

1.7 Structure

For the comfort of the reader, this section is an outline of the thesis; it is divided into seven principal Chapters, from chapter 1 to 7.
Furthermore, an introduction shall be presented at the beginning of each chapter to make it more lucid.

Chapter one, as already seen, is an introduction and background to the thesis. Based on the scope of this thesis and the research questions, we shall present the literature analysis (chapter 2), which provides vital concepts, descriptions and theories relevant for our research questions. The next section (chapter 3) gives an overview of the case study. Chapter 4, research methodology, shall provide an account and render clarity on the strategies, choice, techniques and theories to conduct our research.

Chapter 5 presents our findings based on the answers from the questionnaires issued. The following section shall analyse the data collected in a systematic approach (chapter 6). The final chapter entails discussions regarding implications, conclusions drawn, limitations and recommendations for future research. Figure 1.0 below illustrates the structure in a pictorial form.

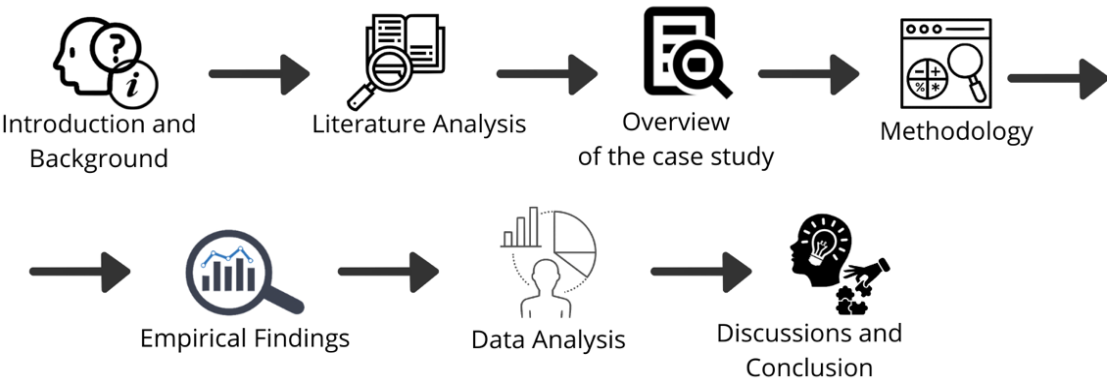


Figure 1.0: Thesis Structure

Chapter 2

2.0 Literature Analysis

2.1 Introduction

This chapter of the thesis analyses and presents the background of researchers and literature on crowd shipping, last mile delivery and its implementation. This chapter will also give information on urban public transport and the shared economy. Additionally, the chapter will provide the readers with current industry situation and provide a frame of reference.

2.1.1 Why Literature Review is Done

Some researchers see literature review as nothing but just a summarised collection of papers or an explained annotated bibliography of several types of research, (Webster & Watson, 2002), A well-structured literature review means more (Levy & Ellis, 2006). As defined by Webster and Watson (2002), a literature review is said to be effective when "*it creates a firm foundation for advancing knowledge. It facilitates theory development, closes areas where a plethora of research exists, and uncovers areas where research is needed*".

Levy & Ellis in 2006 explained why literature review should be done, below are the points they enumerated

- Aiding the researcher to comprehend the existing body of knowledge (what is already Known?) and which areas need to be researched (what is not known?)
- This gives a good theoretical framework for the study being researched
- Substantiating the existence of the main research problem
- To cement and confirm the study being done and will contribute to the body of knowledge
- Conducting a formidable research approach and methodologies, research questions for the study being done.

The intention of the research is to evaluate the willingness to pay for the crowd shipping service and its impacts on the environment and the economy. In doing so, the discrete choice model shall be employed. In that regard, we shall review some literature relevant to our research.

2.1.2 Methodology of the Literature Review

This research examines the scientific literature that is related to crowd-shipping and its application to business or e-commerce, especially in last-mile delivery. The main goal is to have a holistic overview of scientific researches on this topic and comprehend the current body of knowledge, identifying possible gaps and identifying what future search possibilities on this topic are.

A systematic structure on how to achieve an effective literature review suggested by Hart 1998 was adopted.

- Save an annotated copy of every book, article, website, electronic format and hard copy of conferences proceedings
- Note or highlight important things that could be applied to your research; it is important to highlight anything relatable because it is not possible to tell if it will be needed in the course of the work
- Personally, note the methodologies, definitions and discussion etc. of articles used
- Summarise annotated bibliography that encompasses all important information applicable to the research being done; this is not equal to the abstract of the article
- In the course of reading make sure to note the terms and expressions that could aid backwards and forward-searching
- Never forget always to put articles used in the context of the body of knowledge, via constructs, theories, literature streams and models.

Also suggested by Mangiaracina et al. (2015) and Perego et al. (2010) through a three-step process of performing a literature review was adopted.

In the first stage, several articles identified using keywords related to the macro-topic were collected and selected. Using the Molde University online search engines, it was possible to access literature used in this study, including books, periodicals, articles, credible websites thesis of doctorate and other documents.

In the second stage, all scientific articles were analysed, all studies that did not meet the specific requirements were eliminated.

In the final stage, we collected the relevant literature and identified possible research gaps and future studies.

Based on the above, we developed our own methodology for the collections and utilisation of literature.

- Identify and note keywords methodologies and topics related to the macro-topic
- Search widely for related topics, keywords and methodologies
- Gather and save a copy of every book, article, website, electronic format and hard copy of conferences proceedings
- Scrutinise all saved or collected literature based on relevance, methodology and date published
- Summarise the collected relevant literature
- Identify Research gaps and possible studies.

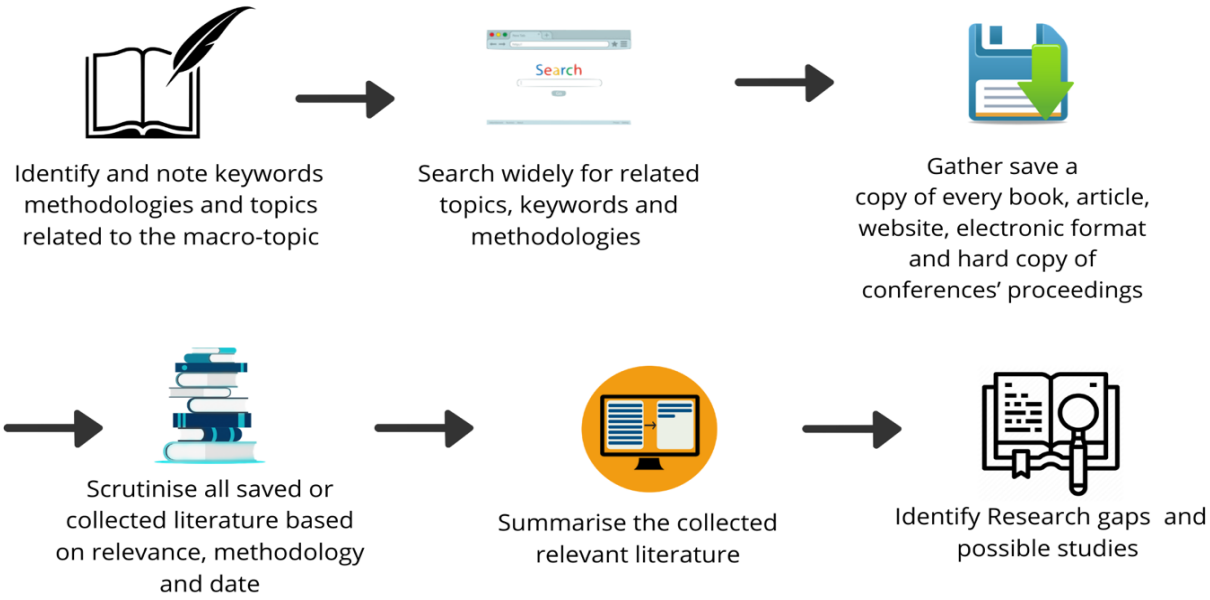


Figure 2.0: Methodology of the Literature Review

2.2 Connection Between Research Questions and Theory

To understand the literature review, the topics are related to the above-mentioned research questions; this table shows what research question each topic answers.

Table 2.0: Connection Between Research Questions and Literature Review

Research Questions	The Literature Review Section

1. Under what conditions are people willing to act as crowd shippers?	Mobility in Urban Areas • Last-mile Delivery • Shared Economy • Crowd shipping/logistics and Deliveries • Sharing economy: regulatory framework • Key Regulatory Issues and Approaches
2. What is the demand for crowd shipping services and crowd shippers?	• Mobility in Urban Areas • Last-mile Delivery • Shared Economy • Crowd shipping/logistics and Deliveries • Sharing economy: regulatory framework • Key Regulatory Issues and Approaches

2.3 Mobility in Urban Areas

2.3.1 Urban Transport

Per the European Commission (2015), more than 60% of European citizens live in an urban area. As stated by Montgomery (2008), the percentage is expected to reach two-thirds of the world's population by 2050, with the world's total population expected to grow by about 2 billion of which 86% will live in semi-large cities.

The reasons are globalisation, greater job opportunities and the presence of better services, as well as the more significant investment by the local governments. This increase in population in cities has created some transport challenges for administrations and transport management authorities. According to the European Commission (2015), urban mobility is the cause of 40% of all CO_2 emissions from road transport and is, therefore, one of the most critical issues in sustainability and pollution today.

According to Anderson, Allen and Browne (2005), urban freight transport is important for many reasons, both in terms of human daily activities and in maintaining the industrial activities of the society. Additionally, efficient freight transport contributes to the competitiveness of industries and the total costs of freight transport. Logistics play a significant role in the efficiency of the economy.

Also, Cristea et al. (2013) observed that vehicles carrying goods in the urban cities emit more emissions than private vehicles due to high consumption per kilometer and diesel power, creating several negative impacts environmentally, socially and economically on the society (Allen et al.,2000b, p. 72 and Muñuzuri et al., 2005). According to Muñuzuri et al. (2005), only the costs of "environmental damage" from pollution due to increasing traffic in European cities amounts to about 100 billion euros per year, which is 1% of the GDP of the European economy.

2.3.2 Urban/City Logistics

The urban flow of goods is also known as "*urban movement of goods*", "*urban transport of goods*" and "*urban logistics*" (Slabinac, 2015). The concept of urban logistics was defined by Taniguchi, Thompson and Yamada (1999) and Ehmke (2012, p. 13) as "*the process of fully optimising logistics and transport activities by private companies in urban areas, taking into account the traffic congestion and energy consumption in the context of a market economy*".

Although movements of goods are relevant in supporting, economic life in urban areas, city-logistics often plays a secondary role in the urban economy (Muñuzuri et al., 2005). According to Russo and Comi (2012) this is because of the conflicts of interest present in the urban areas presented by the public authorities and the private companies. Public authorities want to reduce the impacts of transport to improve the lifestyle of residents and visitors as opposed to private companies wanting to collect and deliver the goods at the lowest costs with the highest quality to meet the customer expectations.

According to Hesse (2008), cities have historically been built based on cars only, while the current road network is often designed without (ERTRAC, 2014). Also, with the increment of trucks, the capacity is no longer suitable and creates congestion. As stated by the European report by the Express Association (2015), the growth of e-commerce has accentuated truck activities and increased deliveries and acquisitions in the urban area congestion. This situation in urban areas is an obstacle to an effective urban distribution network, which is key support for the development of e-commerce in Europe.

Arvidsson (2013), described the issue of efficiency in freight transport as *"a set of measures* of *use of time, space, vehicle, fuel, the driver and the movement of goods."*

According to Muñuzuri et al. (2005), solutions related to the optimisation of urban logistics are not defined from the point of view of transport companies. Additionally, the solutions adopted by the various local administrations in terms of urban logistics, often, are not beneficial for logistics companies. They are developed with the aim of regulating and managing deliveries of goods in urban areas (Muñuzuri et al., 2005). Stated by Taniguchi, Thompson and Yamada (2012), this can lead to some conflicts due to the different views of the various stakeholders. However, these conflicts can be modelled and resolved by a "multi-policy decision tool" An example of these decision-making tools may be the combined criteria analysis method (MAMCA) proposed by Macharis et al. (2009).

The environmental impact in cities is described as one of the effects of transporting goods and passengers in urban areas (Allen et al., 2000b, p. 72, and Muñuzuri et al., 2005). According to Russo and Comi (2012), urban areas are responsible for 80% of greenhouse gas emissions (GHGs) and consume about 70% of energy. Congestion in urban areas is mostly responsible for this increase in pollution in the environment, as stated by Silvia and Ribiero (2009), emissions are dangerous to the health of the population, they are responsible for 70% of the perilous cancerous substances in the air as stated by Santen (2013). Arvidsson, Woxenius and Lammg' rd (2013) stated that in recent decades there had been a greater awareness of environmental problems. This is due to local authorities focusing on making urban freight transport more sustainable (Quak and de Koster, 2009).

2.3.3 Last-mile Delivery

According to Slabinac (2015), the last mile delivery represents the last part of the supply chain that is considered the most inefficient part for its specificities. The delivery of the final product to the customer's door is seen as the most challenging part of logistics (Boyer, Prud 'homme and Chung, 2009). The growing importance of technologies in recent decades have lifted the costs of last-mile deliveries from 13% to 75% of total supply chain costs.

According to Boyer, Prud' homme and Chung (2009), a product can be delivered to the end customer by different types of last-mile deliveries. When choosing a type of delivery, companies must also find the balance between the four critical factors that are "customer convenience, delivery costs, efficiency and capital investments". By choosing the best options,

companies will have to avoid the main urban delivery issues presented by Gevaers et al. (2009), which are the deliveries at home when customers are not at home, areas with low delivery density, the problem of returns and empty returns.

As indicated in the ERTRAC (2014) report, infrastructure and new concepts for the design of distribution centres must be found to make last-mile delivery more efficient. The delivery of the last-mile is one of the most critical difficulties in a Company to Consumer e-commerce. With the rising amount of purchases conducted online, retailers are under obligation to deliver rapid product delivery to customers (Barclays, 2014). These days, retailers give their customers options for home delivery and pickup in warehouses or pickup points. Recently, numerous studies have been conducted on the level of customer expectations regarding reliability and timely delivery of ordered products online, for example using drones for delivery (Slabinac, 2016).

Urban product delivery is a crucial part of a product supply chain and can compromise the relationship between retailers and their customers. This issue has become one of the weakest link of eCommerce (Wang et al., 2014). In their bid to improve operational efficiency, and decrease costs, many companies strive to employ different approaches to delivery in cities.
There is an expanding number of studies on the use of crowdsourcing and crowd-shipping as a solution for freight transport in the city logistics. It is one of the key themes explored as an attempt to solve logistical problems in urban areas (Mehmann et al., 2015).

2.3.4 Courier, Express and Parcel (CEP)

The Courier, Express and Parcel (CEP) is an industry that has been growing in the last 25 years and is considered very strategic and impactful in globalisation (DHL, 2008; Ducret, 2014). According to the report from ATKearney (2015), the CEP market in Europe accounted for a volume of 43.1 billion euros, for 5.4 billion shipments in 2013.

Couriers provide seamless transport and take care of the documentation, the average shipping weight is 1.5 kg, with delivery the same or the next day for shipments national stomps. The market is fragmented in many small businesses, and the service could be national or international (DHL, 2008). Express services consist of quick and reliable deliveries for all types of documents and packages (Dieke et al., 2013). To ensure speed in deliveries, express

suppliers often use their air transport service, which could cover the entire globe (DHL, 2008; Dieke et al., 2013). Packages are characterised by the transport of standardised units, with delivery times of two or three days nationwide. Delivery time allows for a higher level of consolidation and expected transport by road with cheaper deliveries (Dieke et al., 2013).

While a clear boundary between these three areas of activity existed ten years ago, researchers agree that nowadays, the border is blurred (DHL, 2008; Dieke et al., 2013). Two main trends are discussed in the literature regarding the current situation in the CEP sector: the growth of B2C volumes and the issue of urban distribution of goods.

Basically, e-commerce continues to fuel B2C activities, now also surpassing the B2B volume in all European countries (ATKearney, 2015). Although most transport providers seem to increase their focus on B2C deliveries as it is regarded as the most promising business segment, some challenges remain, such as the last-mile problem (ATKearney,2015). While traditional logistics companies are still facing the challenges of providing adequate solutions to the last-mile distribution through partnerships, new interlocutors are showing an example of how a micro-level of delivery can be achieved through crowdsourcing and IT (KPMG, 2015). The second trend in the sector is that urban distribution of goods has become a problem for cities and local governments, for different reasons, such as the economy, the environment or public health (Ducret and Delaitre, 2013). Due to the implementation of regulations for city logistics, a new segment of CEP called “urban parcel delivery service “seems to emerge. (Ducret and Delaitre, 2013). Demand for shorter transit times and more frequent deliveries, the growth of B2C deliveries and the development of home deliveries by physical retailers to cope with the e-commerce, are among the reasons behind the problems of the last mile and the problems of urban distribution (Ducret and Delaitre, 2013; ATKearney, 2015).

In conclusion, the CEP sector is experiencing steady growth supported by e-commerce, but even if the market is growing, there are still problems companies need to deal with like urban areas increasingly subject to administrative limitations. Thanks to innovative and sustainable business models, the new frontiers of transport take advantage of the current situation to create partnerships with traditional operators to acquire shares of the market in last-mile deliveries.

2.4 Shared Economy

Different researchers give it different names, collaborative or sharing economics (Owyang, 2013; Malhotra and Van Alstryne (2014), collaborative consumption (Botsman and Rogers, 2010; Belk, 2014), or peer-to-peer business (Sundararajan, 2014). It is a disruptive economic model that seems to affect every sector of the society, businesses and governments (Owyang, 2013). While Belk (2014) defines shared economy as "coordinating the acquisition and distribution of an asset in exchange for compensation", Cohen and Kietzmann (2014) describe the sharing economy as the process "where people offer and share underutilised resources they own."

The sharing economy spans many industries, but the most successful is transportation (Ernst & Young, 2015), where the best-known companies are car-sharing and apartment sharing examples; Uber and Airbnb.

Even though the sharing economy has grown into entirely different businesses, Sundararajan (2014) explains that they are based on a standard structure. He distinguishes three distinct components: platforms, entrepreneurs and consumers. Platforms are the organisation that provides and organises the sharing ability, entrepreneurs are the individuals or small businesses that create the supply, and consumers represent the demand (Sundararajan, 2014).

Businesses in the sharing economy seem to face a significant problem. Their platforms face regulatory problems since they are regularly accused of violating existing rules and regulations (Owyang, 2013; Ernst & Young, 2015 examples. France has banned "UberPop" the low-cost service of Uber, which used drivers without a professional license (Scott, 2015). Tax compliance seems to be another problem for the sharing economy, which is often accused of unfair competition (Ernst & Young, 2015). Another problem for the sharing economy is the lack of trust between consumers and entrepreneurs, coupled with security concerns (Owyang, 2013; Ernst & Young, 2015). Additionally, as evidenced by Sundararajan (2014), the new services bring new applications for liability, hence the need to bring new types of insurance.

Regarding trust and security concerns, the concerns of the platforms are to provide secure and trusted services because their revenue is based on the volume and expansion of the business (Sundararajan, 2014). They are also closer to the transaction phase and therefore, can act quickly to remove users who violate regulations. Besides, the platforms have created identity

verification processes and credit scoring systems, examples Uber and Airbnb (Sundararajan, 2014); also, reputation systems with social networking features such as Facebook through a link (Owyang, 2013). Altogether, these confidence mechanisms seem to make the exchange easier for most businesses in the economy that they share without additional external policies to protect consumers and regulate the industry (Sundararajan, 2014).

2.4.1 Crowd-Logistics

The combination of shard economy and shared logistics is often called “CrowdLogistics". In the 2014 issue of the DHL Logistics Trend (Bubner, Helbig and Jeske,2014), crowd-logistics is recognized as a promising trend within the next 5 years. Mehmann, Frehe and Teuteberg (2015) after conducting a systematic review of literature and case study on crowd logistics defined it as *"outsourcing of logistics services to a mass of actors whose coordination is supported by a technical infrastructure. The* purpose *of crowd shipping is* to *achieve economic benefits for all stakeholders."*

Crowd-Logistics services could make better use of 60% of the currently unused available transport capacity, resulting in reduced transport costs and reduced CO_2 emissions (Bubner, Helbig and Jeske,2014). It enables the creation of new logistics services and the improvement of traditional services in terms of volume, speed and flexibility (Mehmann, Frehe and Teuteberg, 2015).

According to Bubner, Helbig and Jeske (2014), a strong potential is achieved by outsourcing first and last mile activities by combining professional processes with people's daily routines. so, traditional players must compete with a start-up market, which leads them to create new business models based on "professional and non-professional services, sources and capacity" (Bubner, Helbig and Jeske,2014). This is consistent with what Carbone, Rouquet and Roussat (2015) claims, crowd-logistics represents both a threat and an opportunity for suppliers of logistics services.

Crowdsourcing Delivery

One of the emerging research ideas for solving the latest delivery issues in urban areas is the exploitation of crowd logistics. Crowd logistics, can rely on crowdsourcing (defined primarily as outsourcing a task to a crowd), indicates outsourcing of logistics services to a crowd, reaching economic benefits for all parties involved (Mehmann et al., 2015). The proliferation

of instant communication technologies allows logistics providers to consider this new opportunity in an integrated city-logistics with the company. The synthesis of end-to-end data sharing based on consumers devices inside the logistics process ensures a competitive advantage for e-commerce.

Crowdsourcing delivery is a part of crowd-logistics and is defined by Lam and Li (2015) as: "a web courier service that exploits large groups of geographically distributed individuals to match supply and demand ". It is based on the Internet and often exploits the technological potential of geolocation applications (Rouges and Montreuil, 2014). The reasons behind the recent emergence of these services are many. According to Rouges and Montreuil (2014), it is a response to the ever-changing needs of customers towards faster delivery, personalised and cheaper service. This correlates with Lam and Li (2015). They asserted that in today's world of speed, retailers are trying to reduce delivery costs by increasing speed and convenience to improve the customer experience.

Also, online retailers are willing to develop more efficient delivery systems (e.g. one-day deliveries, free returns, etc.), which could be managed through crowdsourcing delivery. Additionally, "physical" retailers are looking for a way to compete for the comfort of shopping from home because they are affected by e-commerce competition, crowdsourcing delivery could be one of their solution (Rouges and Montreuil, 2014). Finally, as more goods transported via crowdsourcing, externalities such as (emissions, noise, etc.) can be reduced (Rouges and Montreuil, 2014; Paloheimo, Lettenmeier & Waris, 2015).

Rouges and Montreuil (2014) have developed a type of business model in the crowdsourcing sector; they identified five types of business models that categorises each existing service in this area. The first is the Courier business model, with a (B2C) Business-to-Consumer and an intra-urban scope. Customer orders come from an online store and require home delivery, which is included in the payment. A courier, both professional and non-professional, guarantees the order.

The second is the Intendant business model, which has the same characteristics as the Courier. The distinction rests in the event that the customer makes an order on a platform, and the courier performs both the purchase and the delivery, from the store purchased by the customer.

The third is the "intra-urban" model, with a peer-to-peer prevalence, and an intra-urban scope as the name suggests.

The fourth is the "national" model, with a peer-to-peer prevalence and a long-distance or national scope. It works exactly like the "intra-urban" business model, but travellers transport packages due to long distances, and prices can be negotiated. The fifth is the "social delivery" business model, which is also mostly peer-to-peer, but with a national or international scope. The customer places an order on a platform, which is picked up by a traveller who purchases the specified product and delivers it to the final recipient for a price negotiated. The five business models are summarised in the following table.

Table 2.1: Business Model

Name	Clients	Offer	Couriers
courier	B2C	Deliver an order from a shop, restaurant, etc intra urban	Professional or non- professional Dedicated couriers
intendent	B2C	An order is placed on the platform. It is the courier who purchases the article from a shop and delivers the article to the customer. Intra urban	Professional or non- professional Dedicated couriers
Intra-urban	P2P or B2B	Deliver a parcel. Intra urban	Professional or non- professional Dedicated couriers commuters
National	P2P or B2B	Deliver a parcel. Intra urban/National	Travellers
Social Delivery	P2P or B2B or network	An order is placed on the platform. The courier proceeds to purchase and then to delivery. National/ International	Travellers

Source: Rouges and Montreuil (2014)

These new crowdsourcing delivery services have numerous benefits for stakeholders. Companies can reduce logistics costs and customers enjoy cheaper deliveries than traditional deliveries (Rouges and Montreuil, 2014; Lam and Li, 2015). Among other things, it also helps to decrease externalities related to transport, such as congestion, emissions, etc., as services can be provided by people already on their way to the same destination , and with less polluting

modes of transport such as bicycles and public transport .In addition, flexible job opportunities may arise in order to generate wealth for society, Lam and Li (2015) add that these services can provide flexibility for business logistics, because the workforce is available on-demand, and can also help to meet the growing demand for ecommerce logistics. The speed of service is another advantage, traditional companies mostly offer one trip a day (Rouges and Montreuil, 2014). The customization is also superior, the courier and the customer can organize and plan their service. Finally, it gives customers the opportunity to access products otherwise unavailable, such as products sold in foreign locations, restaurants without delivery service, etc... (Rouges and Montreuil, 2014). Nevertheless, crowdsourcing delivery faces many problems, some of which are common with those generally addressed by the sharing economy. Many security issues emerged, such as theft, damages, transport of illegal products, etc... and this goes hand in hand with liability concerns, as it is not clear which person is responsible for problems (Lam and Li, 2015). There are also privacy concerns when retailers may need to share customer information such as home addresses or shopping habits with a courier (Lam and Li, 2015). Rouges and Montreuil (2014) highlights the problem of trust, as it is easier to trust an employee from a reputable transport provider than a stranger. In addition, the platform is based on the same type of solution mentioned above for the sharing economy: secure payment, "log-in with Facebook", ratings and feedback, etc. Another problem is what Rouges and Montreuil (2014) calls "the issue of critical mass". In fact, a certain number of couriers is needed to provide a flexible and responsive service, but a certain number of customers is also crucial to attract casual couriers.

Crowd-shipping

Crowd shipping is a growing industry and has a very high potential of changing the industry some of the advantages are related to lower shipping costs (Miller et al., 2017), the reduction of traffic and its externalities such as pollution (McKinnon et al., 2015).

Also, many challenges relating to trust and accountability issues have been identified. (Rouges and Montreuil, 2014).

Most crowd-shipping start-ups have emerged in the United States (e.g. Postmates, Deliv, Roadie, Kaargo, UberRush), other crowd-shipping platforms are distributed globally with examples in Australia (e.g. PostRope, Ppost), Colombia(Rappi),Nigeria (Max), China (Renren kuaidi),Europe (e.g. PeggyBee, Nimber in the UK and Norway, Trunkrs in the Netherlands,

PiggyBaggy in Finland) or in all countries (Parcelio, Quincus). Despite the market in strong innovation, only a fraction of new crowd-shipping companies manages to create a sustainable market over time by attracting and retaining users (Dablanc 2016).

(Edoardo Marcucci, et al, 2019) aims at comprehending and evaluating the environmental and economic impacts of a crowd shipping platform in urban areas. The research was conducted in the city of Rome and considers environmental-friendly crowd shipping based using mass transit network of Rome, crowd shipper's drop-off and pickup goods in automated lockers stationed in transit station or its environs. The research entails, estimating the willingness to pay for a crowd shipping service to determine potential demand. The model adopted is extensive stated preference survey and discrete choice modelling. Different scenarios with several features were considered up to 2025 regarding revenues and externalities (local and global emissions, noise emissions and accidents reductions). Results from this article are useful to comprehend and estimate the potential of this strategy for last-mile delivery (Business to Company).

According to Simoni et al., 2019 crowd shipping shows alternative shipping to the traditional delivery systems. Although some benefits in terms of decreased pollution and congestion could be obtained by substituting dedicated freight trips, the effect of crowd shipping is unclear and depends on numerous factors. For instance, private drivers can use their old routes or engage in new routes to either pick up and drop parcels off; in the same light, public commuters can also pick packages and drop them off at designated locker stations.

Analysis in this article is a simulation-based approach in relation to the impact of implementing the alternative. Also, for the last-mile delivery operations, a hybrid dynamic traffic simulation is used in a way that macroscopic features of traffic such as triggering of congestion, queue spillbacks and interactions with traffic signals are remade in conjunction. With the microscopic attributes of delivery operations such as delivery vehicles are tracked along their routes.

The impact on traffic and pollution are researched by the adoption of crowd-shipping carriers delivering parcels in Rome. The Results represented not only is the model adopted by crowd shippers are important for the sustainability of such a measure, but it showed operational sphere engulfing the length of the detour, parking behaviour, and daily traffic variations. Simoni et al.

(2019) concluded that “Crowdsourced deliveries by car have generally higher negative impacts than corresponding deliveries by public transit”.

Rześny-Cieplińska and Szmelter-Jarosz (2019) present evaluation results for crowd logistics solutions from the viewpoint of the requirements of different stakeholders. The uniqueness of their study prevails in entering these requirements in the implementation of the three spheres of sustainable growth in cities (social, economic, and environmental). The essence of their publication was to present the benchmark solutions for the crowd logistics field, serving to adjust the business model and market proposal of other providers to the requirements of different groups of stakeholders. The reason for such an estimate is the rapid sharing economy development in the city logistics field, as well as in the courier enterprise.

Rześny-Cieplińska and Szmelter-Jarosz (2019) employed the AHP (analytic hierarchy process) method to develop the recommended evaluation tool of the crowd logistics initiatives. The evaluation criteria (the requirements of groups of respondents) were stemmed from document-based data interpretation, and the primary data for the model are determined from data furnished by service providers. The record of the most suitable solutions was created for designating benchmark brands on the market. The recommendations for managers were derived upon how to adjust answers to the stakeholders’ requirements.

Punel et al. 2018, analyses the users and non-users of crowd shipping in 2018, the proportional t-test analysis and a binary logit model are used to examine why and to what extent the behaviour, choices, preferences, and characteristics of crowd-shipping customers differ from non-users. The results show that (1) crowd-shipping is very dominant among the youth, men, and fully employed persons, (2) the urban areas are preferred when implementing crowd shipping and developing it and (3) crowd-shipping users are more likely to use the crowd shipping service for medium-distance deliveries. The findings helped in the comprehension of the cooperation of the rising shipping framework and client dynamics by giving a pioneering examination of the determinants of crowd-shipping use.

2.5 Sharing Economy: Regulatory Framework

2.5.1 Introduction

The growing development of sharing practices in the sharing economy has raised several questions about how this new form of economy needs to be regulated.

In view of this, the section first presents the different definitions of the concept of innovation proposed by the economic literature, with a reflection on the possibility of defining the sharing economy as a form innovative economic. The delicate question of the relationship between innovation and regulation requires regulatory solutions to the existing framework. In details, this chapter addresses the issue of taxation and the protection of workers' rights in the context of shared economy and crowd sourcing.

2.5.2 Problem Definition and Innovative Regulatory Services

Workers under this economy find it difficult to be classified, since they are given no fixed contract, working hours or guaranteed minimum wage, which makes regulating very difficult.

The term on-demand economy first entered common parliament in early 2015 (the economist 2015) because of the extensive media exposure of Uber-related issues.

The few interventions on the subject do not clarify or detach it from shared economy, making it difficult to identify the meaning and boundaries of these different expressions (Maselli, Giuli Botsman, 2015)

The term on-demand economy refers to economic activities based on the use of internet platforms that allows immediate matching between a user who requires a good or a service and another that is able to provide it by sharing the assets, skills, time of which he or she possesses. (Gatta et al.,2019)

It is evident that, at a period when the exchange is carried out through the sharing platform, it is identified as a provision of service for economic consideration. There is a need for many interests globally to be considered and in particular concerning legislation designed to regulate the business that is established and the dynamics that occur (Davidov and Langille,2011).

The challenges facing this branch of law relates to both the legislation and the founding principles.

Regulating a new industry, especially regarding innovation with little knowledge, is very risky and poses a challenge to policymakers. Regulations have always been an obstacle to innovation and creativity, freedom to develop new ideas and openness to diversity. (Gatta et al. .2019)
Economic literature (Stewart, 2010) distinguishes between two types of regulation, economic regulation and social regulation, which generate ambivalent impacts on the process of innovation. The impact of social regulation on innovation is an issue that has been frequently analysed in recent times, especially in relation to the impact of environmental policies on innovation, because of the growing importance that environmental issues have assumed in recent years. Many economists and scholars believe that social regulation and especially environmental regulation imposes additional costs on companies, with the negative effect of eroding their competitiveness on a global scale (Blind, 2012; Stewart, 1981; Magat, 1979).

Environmental regulation, such as technological standards or environmental taxes, obliges companies to allocate a portion of their inputs (work, capital) into pollution reduction, and this proves unproductive for the company itself. This traditional paradigm was challenged by several economists, including Porter and van der Linde (1995). Based on the analysis of some case studies, the two scholars developed the well-known ***Porter Hypothesis***, a theory that social regulation is not only inducing innovation but often increases the competitiveness of companies, increasing the efficiency of production processes and the quality of products. Tighter and more targeted environmental regulations can spur the innovation process in order to offset the costs of the innovation process. It is therefore important, as expressed by Ranchordas (2015) for policymakers to act as adaptive agents in the implementation and adjustment of regulations and policies, in line with the evolution of markets and technologies. For policymakers to develop a regulatory model that is as favourable as possible for all market players, it is first necessary for sharing economy practices to be brought into the market. Miller (2016).

When policymakers are faced with the need for regulations, they may decide to apply to the sharing economy the existing regulatory framework used to regulate traditional forms of the economy or implement new ad hoc regulatory structures. (Gatta et al,2019)

Until now, policymakers have preferred the first solution; however, in the opinion of many experts, like Ranchordas (2015), this solution does not seem to be optimal for several reasons.

First of all, many of the regulations already implemented have not foreseen the development of the sharing economy and are therefore not adaptable to all forms in which it manifests itself, by not considering the level of informality that characterises many of these practices; thus, proving to be too redundant and obsolete.
Moreover, according to Miller (2016) the legal rules designed to regulate traditional forms of economics are not suitable for regular practices, that offers the possibility to private individuals to directly market goods and services, (monopoly of professional actors). Ranchordas (2015) believes that the innovative character of this new form of economy and the different types of services offered to consumers and policymakers must be flexible in trying to implement specific regulations, such as contract and contract obligations, compensation between the parties, minimum safety requirements, competencies and rules on liability.

The analysis of how the sharing economy needs to be regulated also starts from the assumption that it consists of different sharing practices that need the implementation of different regulatory approaches. Although common traits characterise these practices, for example, all are based on the use of the Internet as a channel to share goods and services at a lower cost compared to traditional forms of economics. However, their regulation must take into account that the various types of transactions of the sharing economy differ substantially based on how they operate and target consumers. (Gatta et al.,2019) As stated by many scholars, including Smorto (2015), many of the sharing practices of the sharing economy assume an exchange of goods and services between individuals without remuneration, without understanding the economic and market dimension.
It is reasonable to say, that more restrictive regulations need to be implemented in the shared economy, which will allow individuals to carry out economic activities on an ongoing basis and gain from it as well.

2.5.3 Key Regulatory Issues and Approaches

The challenges presented by the sharing economy in relation to taxation arise mainly because of three issues (Gatta et al., 2019)

Firstly, the distinction between professional service providers, defined by the economic literature with the term micro-business, and users engaged in these practices only occasionally, which will consequently have less incentive to comply with the tax regulations applied.

The second issue posed by the sharing economy in relation to taxation concerns the commercial or private use of the goods and services offered.
Finally, another element that increases the difficulty for policymakers to implement tax regulations appropriate to these practices is the type of tax system adopted in various countries. Some tax systems assume that taxable income on a global basis, such as that of the United States, where every source of income is considered taxable, except for specific exceptions. Other tax systems, such as the Italian one, assume that taxable income is taxed on a scheduled basis, i.e. that a source of income is not to be considered taxable income if not explicitly specified by the legal framework. (Gatta et al., 2019)

Countries have taken different approaches to regulate the taxation of sharing economy practices. Some countries, such as Australia, the United States and the United Kingdom, have taken a more conservative approach, believing that the issue of taxation could be fully adapted to existing tax regulations.

Other countries, on the other hand, have implemented more specific measures for the sharing economy, in the belief that pre-existing tax principles and categories are not enough to resolve all the issues that have arisen development of this new form of economy. In this sense, a strategy adopted by many countries is to develop new tax reporting systems together with companies in the sharing economy.

Another problem is the protection of workers, companies in the sharing economy consider their workers as independent contractors, legally responsible for their work. The status of an independent contractor is considered by many to be the real factor that drives individuals to approach the practices of the sharing economy.

Recently, however, some lawmakers have expressed a willingness to reclassify independent sharing economy contractors into employees. Warren (2016) stated that the big companies in the sharing economy make huge profits from a workforce made up of independent contractors, thanks to a substantial reduction in labour costs. Large sharing economy companies are not required to pay taxes and contributions on their workers' salaries, to guarantee the minimum wage and medical insurance, to overtime pay, etc. However, according to Warren (2016), the

sharing economy does not offer the opportunity for many workers to build solid economic security.

Doescher (2016) states, however, that such a measure would prove devastating in economic terms for sharing economy companies. Sherk (2016), says that the transition to employee status would spell the end of many sharing economy activities, as the control that companies would exercise over activities and the organisation of their workers would result in a weakening their company and eventually the sharing economy.

In conclusion, even though the majority of users who use the sharing economy platforms consider it an action to be carried out during their free time and part-time work, it is prudent to say that in the future the number of people who will rely on this new form of economy to find full-time employment shall increase. As a result, according to Baker (2015), those who work in the context of the sharing economy as full-time workers must enjoy the same protections and benefits as traditional employees. To achieve this objective, the governments of each country must first clearly define what is meant by the term and what types of workers can enjoy the protections and benefits granted to workers in established companies.

2.5.4 Sharing Economy: Legislative Developments in London

In the UK 70% of the population would share their idle assets if it were easy or convenient. The opportunities for the business and entrepreneurs are tremendous, indeed already Airbnb is valued at over $10bn. Wosskow, D. (2014). The Housing Minister Brandon Lewis gave details of government reforms aimed at ensuring London residents can rent their houses out on a short-term basis, without paying for a council permit.

Under a law for Greater London Council from 1973, Londoner who wants to rent out their properties (home) for less than 90 days must apply for planning permission or else face a penalty of up to £20,000 for each offence. The laws are enforced well across London, as was discussed during the 2012 Olympic games. People of London now increasingly want to rent out their homes short-term, to take advantage of internet websites (Airbnb) allowing short-term rents. The reforms will aid boost London tourism by increasing the availability of competitively priced accommodation and reduce the number of houses lying empty. (Anon, 2015)

Following the government, (9 February 2015) published details of how the law will be changed and scaled back while making sure common-sense measures to protect local amenity. (Anon, 2015)

There are currently thousands of properties in London advertised on websites including Airbnb. "*Mr Lewis said London residents must be able to engage in the sharing economy and benefit from the same freedom and flexibility as the rest of the country to temporarily rent their homes, without facing disproportionate rules and regulations*". (Anon, 2015)

For this reason, the government propose to restrict short-term sublet of homes to a maximum of 90 days per annum, so that properties cannot be used for short-term letting permanently throughout the year. This will increase the number of competitively priced accommodation for people to rent, for both workers and tourists, and reduce the amount of empty properties in the Capital. The government will also put in place preventive measures to make sure this new flexibility is not abused, by:

- ensuring that, to profit from the new flexibility, the properties must be liable for Council Tax – thereby exempting business premises
- giving councils the authority to withdraw this new flexibility if successful implementation action is taken against a property owner flouting these rules
- guaranteeing that, in extraordinary situations, councils will be able to demand that the Secretary of State agrees to little localized
- exemptions from the new flexibility, where there is an influential case to do so

This restriction on short-term rent is satisfied by Section 25 of the Greater London Council (General Powers) Act 1973 – the government intends to alter this by the Deregulation Bill before Parliament.

2.6 Literature Contribution

This literature review gives more details on urban freight transports and how crowd-shipping can help the global economic development, especially in the cities. Despite the positive effects, conflicting ideas and interest in the aspect of the stakeholders is a major problem, regulation in this industry is tough and complicated due to its innovative nature and online platform that is associated with it.

However, crowd-logistics is seen as an environmentally friendly solution to the urban deployment capacity problem, and crowdsourcing deliveries are suitable to address growth in B2C deliveries and as a way for physical retailers to cope with e-commerce, especially in urban areas. This literature also helps crowd-shipping in the cosmopolitan environment because this body of work focuses on London and London is a very cosmopolitan city.

Chapter 3

3.0 Description of The Case Study

3.1. Introduction

As shown by literature, crowd shipping may obtain beneficial feedback in many fields, and this has inspired scientific research to carry out to investigate its acceptability.

The following research intends to focus on a well-defined application model, compared to previous studies. As revealed in the initial chapter, the scope of the subsequent research concerns the delivery of packages by crowd implemented to the London metro network and the e-commerce industry. In this section, relevant data of each feature of the service in the industry are shared, described and explained.

3.2. Freight Traffic in London

Increasing urban populations produce an increment in the demand for goods and services that must be distributed in usually very overcrowded metropolitan areas. In London, not only is the total capacity of urban freight increasing but additionally, the essence of these movements has changed drastically in recent years, resulting in vital difficulties in urban logistics operations The UK has one of Europe's busiest fright hubs, Heathrow is regarded as the leading freight handling airport in the United Kingdom since 2007. It processed approximately 1.7 million metric tons of air freight more than.

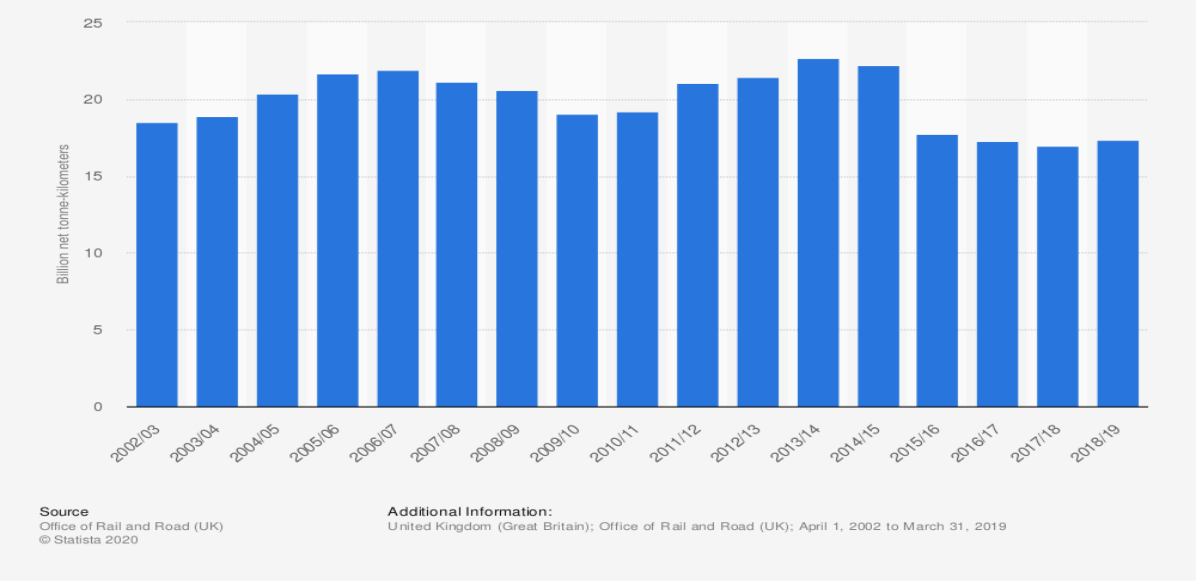


Figure 3.0: Amount of fright moved annually on the rail network in Great Britain from 2002/03 to 2018/19(in billion net tonne-kilometres. (Statista, 2019)

In that same year, the UK registered the most massive quantity of air cargo since 1950. International flights estimated for the highest share of freight moved. Airports in the country handled around 2.5 million metric tons of international air freight in 2017.
The entire rail freight transportation in Great Britain resulted in 17.4 billion net tonne-kilometres in 2018/19; of this, 6.8 billion net tonne-kilometres were recorded by domestic intermodal freight. Rail freight achieved its peak in 2013/14, at 22.71 billion net tonne-kilometres. Since then, the throughput of freight moved yearly has declined, standing at 17.39 net tonne-kilometres in 2018/19.

With Regards to road freight transportation, figures for 2017 stood at to 156 billion tonne-kilometres, with 3.5 million bulk goods vehicles travelling from the UK to Europe. In that very year, freight volume transported to the EU15 by UK-registered vehicles stood at 4 million tonnes and freight capacity transported to Ireland recorded was 1.3 million tonnes.
Also, with maritime transportation, the Port of London recorded the most significant volume of inward sea freight; 44.8 million tonnes of sea freight were received in London in 2018 alone. On the contrary, outward sea freight volume from the Firth of Forth port was the highest recorded for any port, at 22 million tonnes and mainly attributed to the surrounding fossil fuel industry.

3.3. London's Metro Network

The London metro has 268 stations with a total of 11 metro lines. Current, Transport for London data depicts that there are over 2.9 billion entries and exits in total every year, making the London metro one of the busiest metro systems in the world. The metro operates an average of about 6.3 million km per month.

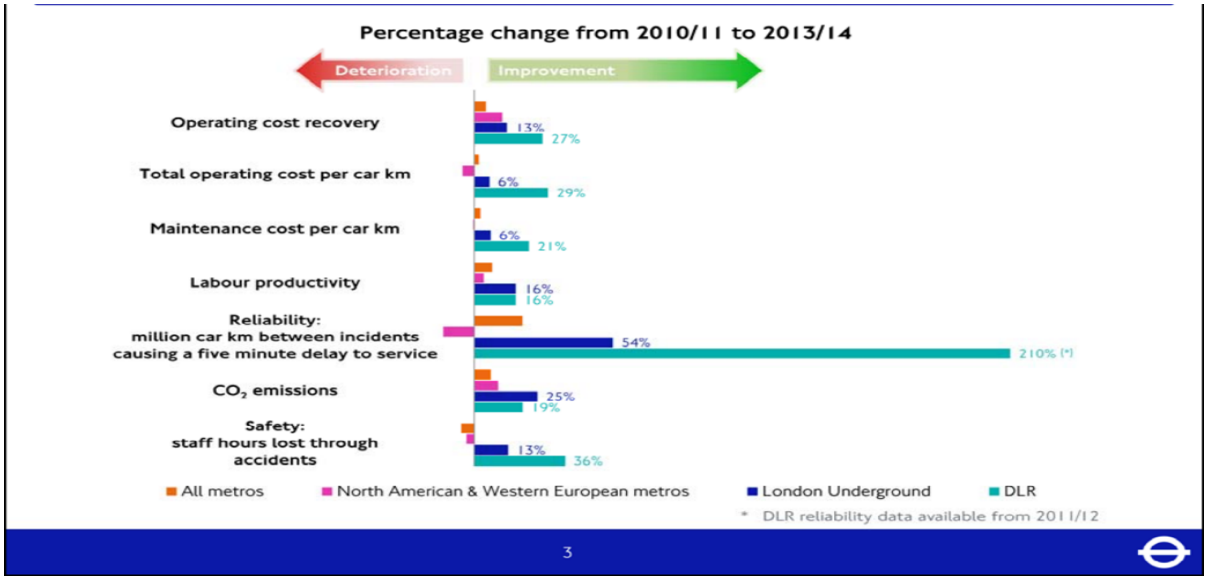


Figure 3.1: London Underground (LU) and Docklands Light Railway (DLR) compared to other metros (Transport for London Report)

The number of journeys on the public transport network by TFL is reported by type of transport. Data is distinguished by cable car bus, underground, Docklands Light Railway (DLR), Overground and tram. Nonetheless the most utilized and recognized metro services are the London Underground (LU) and Docklands Light Railway (DLR).

Over the last years for all lead metrics, London Underground and Docklands Light Railway have both made extraordinary progress. They have developed at a faster pace than the percentage of the average of other Western European, North American metros and all other metros.

3.4. E-commerce in the UK

In Europe, the United Kingdom (UK) is considered to have the most exceptional e-commerce market and a leading position in the retail industry. According to the current data from the Office of National Statistics (UK), e-commerce in 2018 encountered a sharp increase in earnings; revenue from e-commerce amounted to 688.4 billion GBP. On a sectoral premise, the manufacturing and wholesale industries recorded the most sales that year.

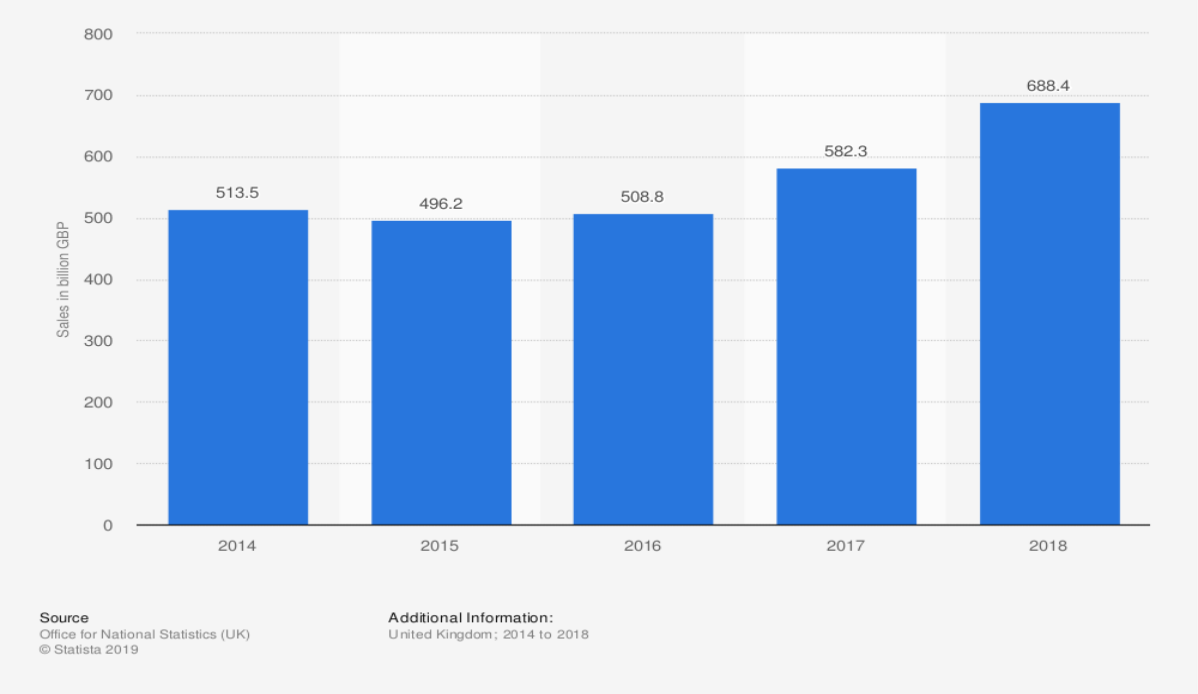


Figure 3.2: E- commerce sales in the United Kingdom (UK) from 2014 to 2018(in billion GBP (Statista 2019)

In The UK, about 8 per cent of e-commerce sales across all industries was recorded by retail enterprises. In 2018, online sales recorded 17.8 per cent of the market share in the retail sector exclusively.

Although the UK is considered the market leader in online shopping, the growth in recent years, however, has been stable; in 2019, internet retail sales improved by 10.1 per cent, the crawling rate compared to other figures from the past ten years. With over one-fourth online retail sales, the clothing and textile stores stand as the most prominent in the retail business, according to government data.

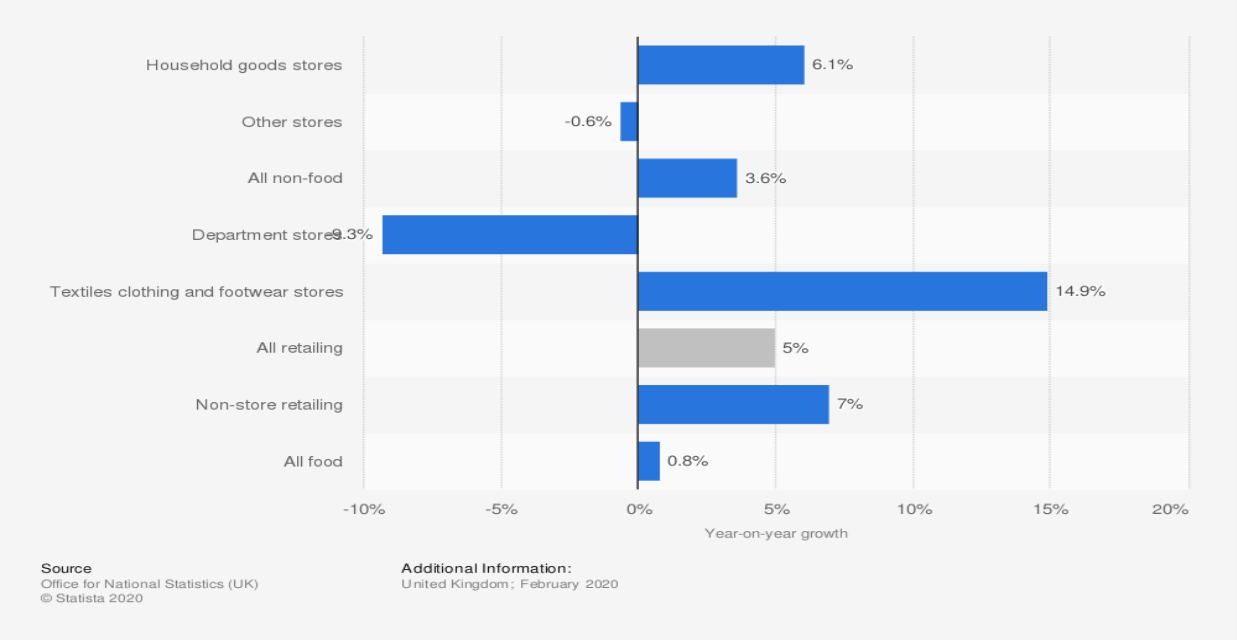


Figure 3.3: Growth in internet sales value in the United Kingdom (UK) in February 2020, by sector (Statista 2020)

Furthermore, according to Tugba Sabanoglu (2020), mobile shopping mobile or commerce is gaining priority within the European market, the share of mobile devices, principally smartphones shoppers, increased in Great Britain over the years. In correspondence, the fraction of customers who utilized mobile payment systems in their online transactions increased, with a growth of around 2 million more users in 2019.

The online shopping scene in the UK is gaining more traction, with more customers skewing towards online purchases. According to Statista (2020), 82 per cent of UK homes made online purchases in 2019, recording the most significant online purchase penetration rate in the past decade. Most purchases made online were notably clothing and sports goods.

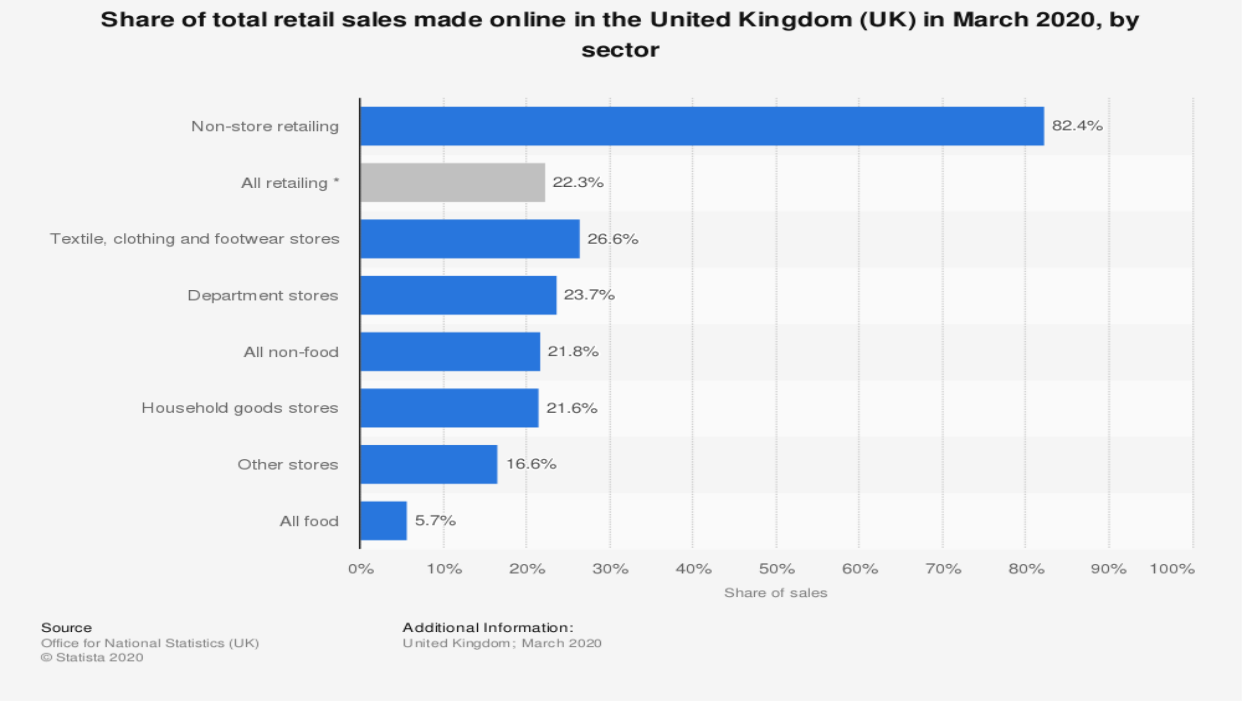


Figure 3.4: Share of total retail sales made online in the United Kingdom (UK) in March 2020, by sector (Statista 2020)

More detailed analysis of online shopping behaviour of consumers reveals that there has been an increase in business to private customer sales. At the end of 2018, the U.K recorded 199.7 billion GBP sales in private customer sales and online shopping is predicted to increase by about 34.5 per cent by 2023.

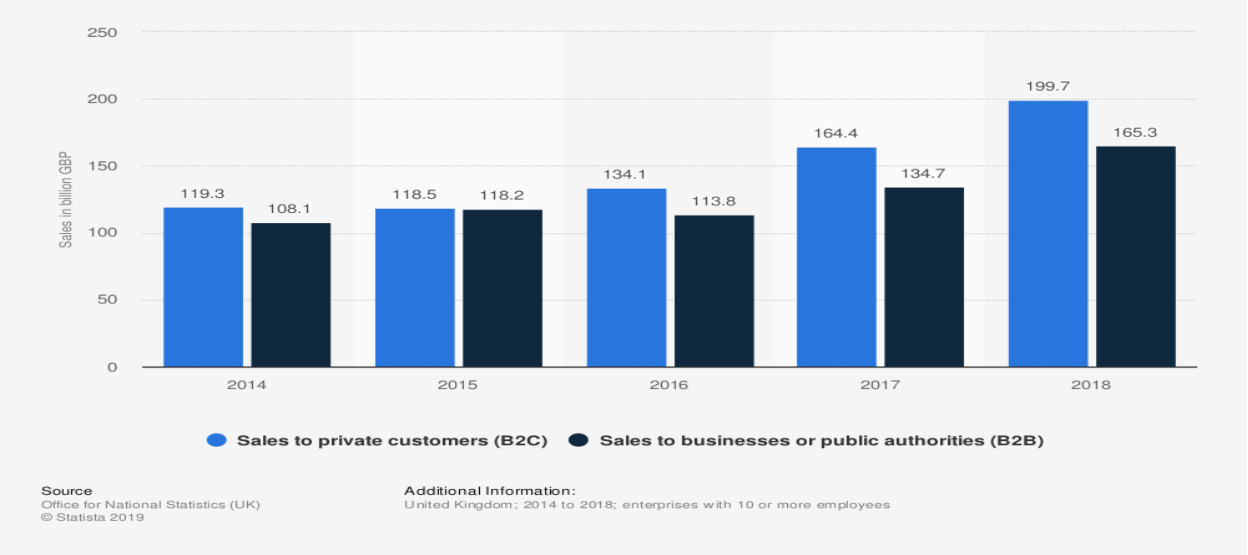


Figure 3.5: B2B e-commerce sales over a website in the United Kingdom (UK) from 2014 to 2018 (in billion GBP) (Statista 2019)

3.5 Description of the Service

A pre-feasibility study aids in the decision-making process and serves as a pilot for possible investment. A pre-modelled study is conducted with essential factors or attributes to determine the market success of a particular system or business, in this case, crowd-shipping in London. The crowd-shipping serve is aimed at providing a dynamic and convenient way to utilise metro transport users as carries to exploit more sustainable, efficient and cost-effective courier system for customers. In other words, the service consists of the transfer of packages via commuters, known as crowd-shippers that would ply the specific route that parcels must follow to reach a designated delivery point for collection by the owner.

Additionally, the final designated delivery point is Automated Parcel Lockers (APL) boxes disseminated in the transport for London underground stops where the traveller would eventually insert the package. In these circumstances, a traveller would decide to make a delivery, pick up the package from a designated point of origin which is another locker to the designated delivery point; as a result, decreasing the freight traffic within the city.
IT services and tailormade applications are going to be employed to ensure its authenticity and fitting functionality of the serve. In that regard, special codes will be used via smartphones to handle all the shipment, including accessing the lockers to ensure safety.
The scope has been limited to the urban context, that is, the last mile of shipments where the greatest costs and inefficiencies of logistics are concentrated, at the same time as the use of London metro service and e-commerce.

The parcels distributed must be of a suitable small size and weight, for easy carriage on the metro. E-commerce product attributes typically possess compatible characteristics; thus, attributes outside the preferred features may be considered as a limitation to the service.
The service may be highly beneficial for retail companies operating on Business to private customer (B2C) basis. Consignments Couriers operating domestically and internationally may also find this advantageous through the incentives in a city logistics context. Packages will be placed in locked as the last delivery point for courier operators then liability is switched over to the crowd-shipping service where a regular traveller is employed to carry packages. Thus, the investment costs for the creation of logistics service is reduced drastically; furthermore, small businesses shall have the opportunity to expand their market area as a result of local e-commerce, since ordered products can be placed directly into the nearest locker delivery.

Chapter 4

4.0 Methodology

4.1 Introduction

This chapter is essential due to how it clarifies the way the research was conducted. This chapter follows the structure; current research questions and purpose, research philosophy, research approach, research strategy, methodological choice, data collection and data analysis, lastly, the validity and reliability of the data were tested.

This chapters' structure will be detailed by using the Saunders, Lewis and Thornhill (2009) six layers of research method, also known as the research onion.

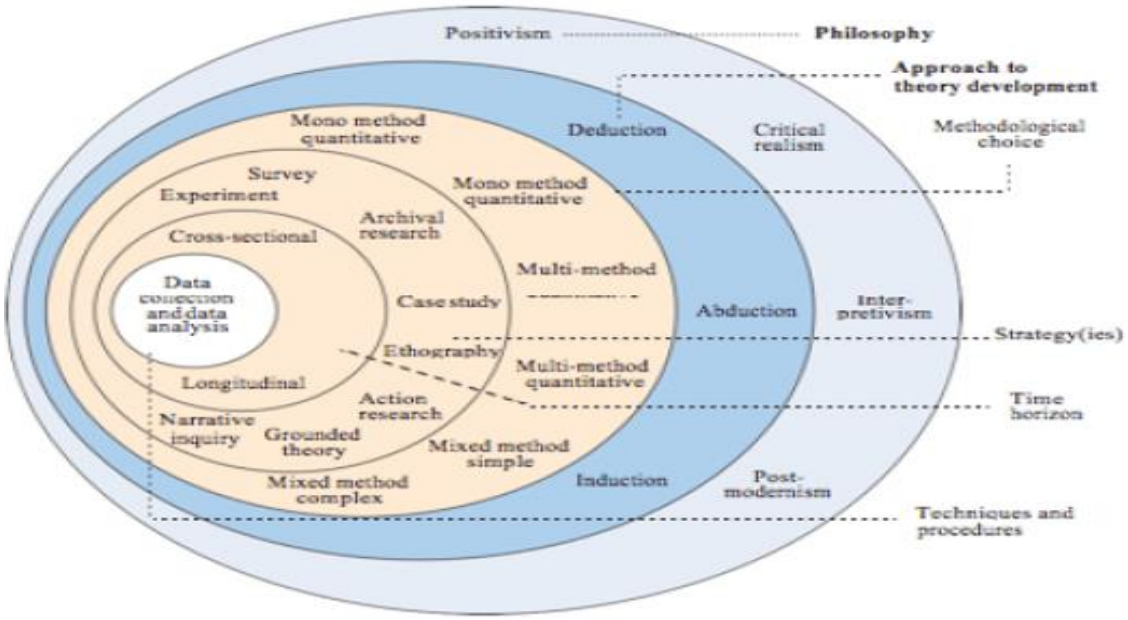


Figure 4.0: The Research Onion Diagram (Saunders et al., 2009, p. 108)

4.1.1 Research Philosophy

In most researches conducted, it is eminent to comprehend the fundamental philosophy used in the research (Saunders et al., 2009). The pictorial representation above the four different philosophies. These are mostly adopted by organisational research: Positivism, Critical realism, interpretivism and Postmodernism /pragmatism.

The philosophy adopted in this research is positivism; this philosophy is employed because it states that researchers use a sizable collection of primary data to prove a theory or support facts, the majority being quantitative methods. (Peiling Zhang and Tingting Li, 2018)

With this thesis, first we conducted a literature review using the approach of Morganti et al. (2015) and Perego et al. (2010), Information on the city of London and crow shipping companies.
Attributes and levels were obtained from primarily literature review and ranked according to the most used and present in literature, We then randomly interviewed focus groups in order to know if the attributes and level really reflect the day to activities, a pilot study was further conducted to know the practicality and reconfirm the final attributes and levels for both demand and supply.
The final questionnaire was then generated using stated preference. As elaborated by Saunders et al. (2012) that results from data collected are analysed and explained to prove the existence of theory, likewise, was done, data was collected and analysed objectively.

4.1.2 Research Approach

Deduction, Induction and Abduction are the approaches on the second layer of the methodology according to Saunders et al., (2015). The deductive approach is explained as beginning with the development of theory through academic literature, secondly take data and lastly design a research to prove the theory already developed (Saunders et al., 2012, p. 144). Availability of reliable and extensive literature is a very crucial prerequisite in performing a deductive approach. On the contrary, inductive approach is defined by starting data collection then to develop a theory or conceptual framework. In furtherance, abductive approach is a mix-method by integrating both inductive and deductive approach.

For this body of work deductive approach is the most suitable, this is suitable because we want the show the relationship between demand and supply preferences to the consumer utility achieved in public based crowd shipping from primary data. Saunders et al. (2012) detailed four stages that can be adopted in deductive research;

- Develop a primary idea or hypothesis to form a theory

- A proposition that can be tested is deduced by using the relevant literature or by specifying the conditions expected in the theory, also show the correlations between the independent and dependent variable.
- Test the grounds by collecting quantitative data to measure the variables
- Analyse the results and modify or confirm the theory previously developed.

Four our deductive approach, we were supposed to find the effect public based crowd shipping has on consumer utility and the environment, Based on this theory developed, we researched for relevant literature form websites, books etcetera which aided in the ascertaining of the attributes and levels, the final questionnaire was developed, data collected and analysed and findings discussed.

4.1.3 Research Strategy

Research strategy is a link between research philosophy and data collection. The research strategy is important in determining the best method of answering research questions and achieving the purpose of the research (Saunders et al., 2012) Eventually the goal is to answer the research questions with the aid of the research strategy. From the research approach, deductive approach was used, in view of this experiments and surveys was implemented as the strategy of this research. *"An experiment is a very precise tool that should only be used when there is a considerable amount known about the phenomenon studied"* (Robson, 2007, p. 35). Pilot study, the simplest experiment was adopted. The goal of the experiment was to ascertain the proportion dependent variables is dependent on the independent variables (Saunders et al., 2012).

In this thesis, the independent variables are the attributes and the dependent variable is the consumer choice or preference. Results generated from the pilot study is enhanced and used in the development of the design for the final questionnaire of the study.

The main study is stated presence analysis, Stated Preference methods refer to a family of techniques that foresee interviewing individuals concerning their preferences (choices) regarding a set of different options (alternatives) differentiated by the characteristics (attributes) they hold. In view of this, we choose survey as a major research strategy.

A survey strategy is mostly adopted when using the deductive approach, the gives researchers better process of collecting numerous amounts of data to satisfy the who, what, where, when and how of any given topic or issue (Saunders et al., 2012)

4.2 Methodological Choice

Methodological choices are two in general which is qualitative and quantitative research methods.

Qualitative research means examining quantity, frequency and intensity of a phenomena Denzin and Lincoln (1994), other researchers may interpret and discover often in the social science (Merriam, 1988). Qualitative research can also be as observations and interpretations of human perception of numerous events and explains individuals' perception into reality (Guba & Lincoln, 1994). (Khan, 2014) defines qualitative research as a process that set to comprehend different methodologies that explore social phenomena. here the study shows a total picture, complex, analyses words and examines in detail a social problem and reported.

Quantitative research can be described as 'positivism' (Duffy 1985) and 'empiricism' (Leach 1990). (Cormack 1991) defines quantitative research as being derived from scientific methods in physical or social science. (Bums & Grove 1987) also describes quantitative research as an approach is very systematic, objective, formal way that numerical data is adopted to measure and analyses phenomena to produce a meaningful result. "*Quantitative methodologies test theory, deductively from existing knowledge, through developing hypothesized relationships and proposed outcomes for study, qualitative researchers are guided by certain ideas, perspectives or hunches regarding the subject to be investigated*" (Cormack 1991). From the prior definitions, quantitative approach is the most effective approach to measure data when the respondents are many (Saunders et al, 2012). For this research, Quantitative research method was used to analyse the data and draw meaning results from the survey.

4.3 Data Collection

Primary and secondary data was identified by (Hox and Boeije, 2005), "Primary data is also called original data which is collected for a specific research goal, while secondary data is information that was originally collected for a different purpose than the study at hand and reused for another research question" (Hox & Boeije, 2005, p. 593). Both Primary and secondary data was utilised in this research

4.3.1 Primary Data Collection Method

Primary data "surveys can be good ways to gather a lot of people's opinions and behavioural data, as long as they do well." Easterby-Smith et al. (2013). This research is studying the consumer choice of Londoners, questionnaires was developed and distributed also interviews was conducted in order to put the data collected in the right perspective. All interviews were conducted in a professional manner.

4.3.2 Secondary Data Collection

The secondary data for this research were obtained from books, journals, Governmental reports and statistics, conference proceedings and articles. Not only these but also other research papers or literature was viewed to gain more insight into the research topic. Reliable websites were used to accumulate data or information.

4.3.3 Sampling Techniques

Saunders et al. (2012) said it is difficult to survey a vast population due to the limited time, access and cost available, In view of the limited resources a sample size has to be chosen , the city of London is the population and the sampling technique used is non-probability sampling technique, it was defined by (Saunders et al., 2012) as "the probability of each case being selected from the total population is unknown and it is impossible to answer research questions or to address objectives that require you to make statistical inferences about the characteristics of the population".

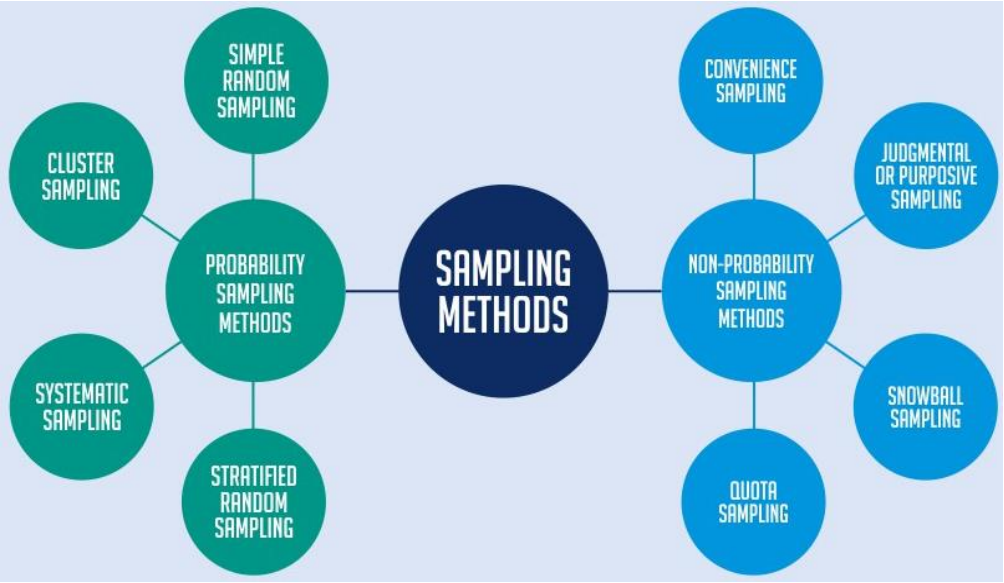


Figure 4.1: Overview of sampling techniques (Saunders et al., 2012)

The pictorial representation above shows sampling techniques, convenience sampling is used in the body of work, it is the most commonly used in the world and effective way of collecting data (Peiling Zhang and Tingting Li 2018). In details, convenience sampling was used to determine the focus groups. The target group were Londoners who use public transport. It was easy to determine because most of the face to face data taken was at the metro station. Also, respondents were allowed to fill the questionnaire only if they confirmed frequenting public transport. With the online data, respondents are asked if they use public transport frequently(metro) before they can proceed to fill the questionnaire. We also made sure the questionnaire was previewed only in the city of London.

4.4 Pilot Study

A pilot study is a fraction and test version of the main research, this is done to reveal the potential problems that could be faced in the course issuing the main questionnaire. (Hassan, Schattner, & Mazza, 2006). A research cannot be said to be good if it does not go through the piloting face. (Saunders, 2012) asserted that a pilot study helps researchers to know the validity and reliability of data to be collected.

In this thesis, Stated Preference analysis takes majority of the questionnaire, and piloting the questionnaire helped in developing an effective, reliable and accurate questionnaire (Easterby-Smith et al., 2015, p.281). After getting attributes and levels through literature review and discussion in focus groups, piloting was done to affirm the attributes and levels. The pilot study was conducted in 4 different metro stations in London (Algate east, baker street, bank and oxford circus stations); to ascertain from the respondents which attribute and level are important when they act as crowd shippers and demand for crowd shipping service. This convenient sampling was tested on 16 respondents 4 in each metro station, (Algate east, baker street, bank and oxford circus stations)

4.4.1 Questionnaire

Questionnaires are widely used to collect data and one of the effective ways to do it in the world of survey strategy. (Saunders 2012). Because each respondent answers the same questionnaire, it is efficient to collect large samples of data. The survey was issued face to face, and distributed online through https://nettskjema.no/ on the Molde University College data collection website , this survey platform easily exports data to excel file or SPSS to avoid mistakes in transferring data from data entering to data collection. However, due to Covid-19

we resorted to more online based formats. (Saunders 2015) stated that there are two types of questionnaires, namely self-completed and interview completed, we used the self-completed for the online data alongside the interview completed to give more meaning and reason why people choose what they choose. Shown below is a pictorial representation of the two types of questionnaire.

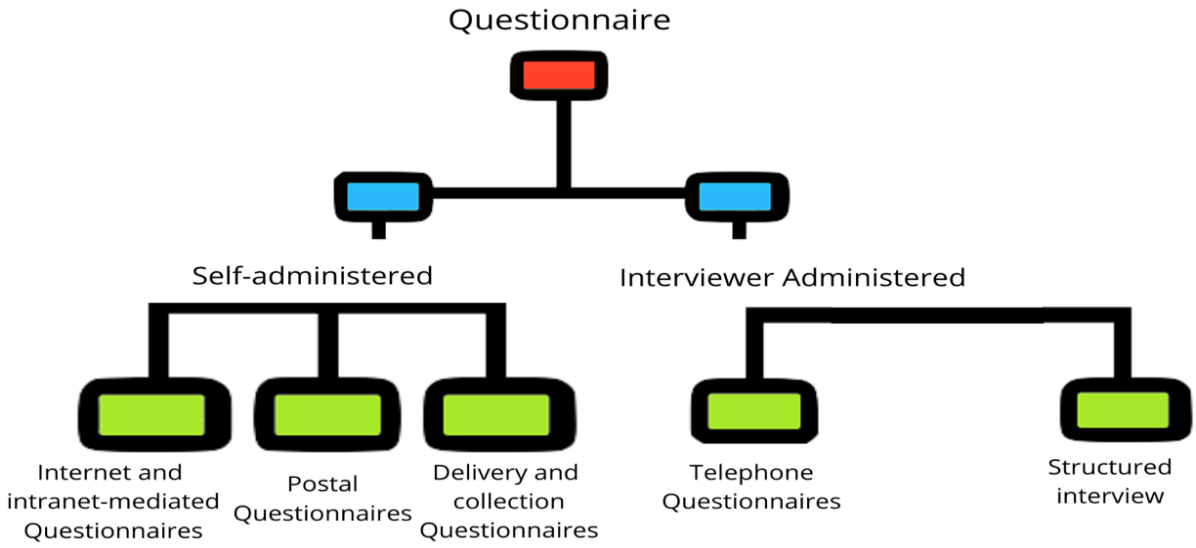


Figure 4.2: Questionnaire Types (Saunders et al, 2009)

The respondents answered the questionnaire that consists of 1) Pre-interview questions 2) Stated Preference data 3) sustainability 4) Post interview 5) socio-demographic for both demand and supply.

4.5 Data Analysis

To ascertain meaningful findings, data must be analysed critically to answer the research questions. (Saunders et al., 2012)

"The quantitative data in a raw form were collected from the questionnaire, that is, before these data have been processed and analysed, convey very little meaning to most people" (Saunders et al, 2012). For this research, we used stated preference module in IBM® SPSS® Statistics Version 24 to conduct data analysis.

4.5.1 Stated Preferences Analysis (SP)

The Stated Preferences surveys refer to that family of data-gathering techniques that involve interviewing individuals to understand their preferences for a set of different alternatives, to enable an estimation of the utility function (Green & Srinivasan, 1990)

SP uses people's responses to different situations created thanks to experimental design (imaginary situations where people indicate how they would respond once faced with them in reality (Marcucci 2019)

The alternatives are representations of goods or services that differ from each other by the levels of peculiarities that make them up. The alternatives are therefore a kind of situations built ad hoc by the researcher through literature and focus groups (Gatta et al, 2019)

Individuals are therefore asked to express their choice by declaring their preferences about the alternatives that are offered to them. There are three systems for expressing your preferences: sorting the alternatives (ranking), assigning a value to the various alternatives (ratings), or simply choosing the preferred alternative (choice) (Gatta et al, 2019)

To answer the research question and objectives of this thesis, stated preference technique aided to collect data by giving respondents hypothetical alternatives of choice.

4.5.2 Experimental Design

Experimental design represents a set of rules in a stated preference and precisely type of choice made (and not ranking or rating) (Gatta et al, 2019).

"The attribute and levels need to be salient in influencing consumer preferences and choices. These data can be identified through discussions with management and industry experts, analysis of secondary data, qualitative research or pilot surveys" (Malhotra et al., 2017, p.706).

In formulating an experimental design, the following steps must be followed

- Select the levels and attributes to use in the alternative description;
- Select the alternatives to be proposed for each set of choice. There are different designs, depending on the number of attributes, levels and alternatives used in the survey.

The better the design the better or more precise the estimation of the attributes and levels.

The design has the properties that can make it either orthogonal or level balancing. A design is said to be orthogonal when the probability of any combination of a 2-level and 3-level attributes occurring is equal to a twelfth. The orthogonality of the design allows to prevent the preferences of the respondents from being dependent on the greater probability that one alternative has more weight than others. meaning the probability that alternative A rather than B is chosen depends solely on the fact that the respondents prefer A to B and not on the fact that alternative A has more weight than B.

Level balancing, on the other hand, requires that each level of each attribute is present in each choice set the same number of times.

Sometimes it is difficult to comply with orthogonality and level balancing at the same time, for example, if one attribute has 3 levels ,2 attributes and 2 choices the balance is not respected. Stated by some researchers, orthogonality of the design does not always guarantee maximum efficiency of the estimates. (Rose and Bliemer 2004) point out that non-response cases alter the orthogonality of design by generating efficiency problems. Hensher and Truong (1983), also emphasizes the importance of considering the realism of the choice sets in defining the design, specifically eliminating those alternatives that are unusable. To eliminate this problem different methods have been developed in experimental drawings, A few of them are; Comparative designs Randomise block designs, Completely randomised designs, Screening designs, Full factorial designs (2 levels), Fractional factorial designs (2 levels), Fractional factorial designs (multiple levels), Regression modeling, D-optimal designs etcetera.

4.5.3 Discrete Choice Model

Discrete choice model is a method which is used to analyse and predict decisions. Willingness to pay is determined from an array of options or choice sets. Ben-Akiva (1985) applies the discrete choice model and presents a detailed framework of general assumptions and how these assumptions are differentiated:

Firstly, *decision-maker*- describes the decision-making variables and their components. Secondly, *alternatives* - defining the choices available to the decision-maker. Thirdly, *attributes* - estimating the advantages and costs of an alternative to the decision-maker. Lastly, decision rule- illustrating the method used by the decision-maker to choose an alternative.

Ben-Akiva also explains the discrete choice model as a disaggregate model and what it entails. According to Ben-Akiva (1999), the decision-maker is as an individual. It is further explained that the decision-making entity may consider a group (typically an organisation) as an individual. "*To explain the heterogeneity of preferences among decision-makers, a disaggregate model must include their characteristics such as the socio-economic variables of age, gender, education and income.*" (Ben-Akiva,1999)

4.5.4 Orthogonal Design

In full design, the set of alternatives used in the experiment is given by all possible combinations of levels of all the attributes investigated , this design generates a large number of scenarios ,it is useful to small issues and can be useful in determining other designs, such as Fractional Factorial design, which shows each respondent a subset of the total choice scenarios. This subset can be chosen randomly, or you can give a scenario of choice to each of the respondents. In both cases, errors can be generated. Orthogonal designs and Efficient designs are used to select the subsets correctly.

The partial design, also called simply Orthogonal designs, as opposed to factorial, also orthogonal uses only a part of all possible combinations of attribute levels, allowing you to analyze only the main effects an interaction that is of greater than or equal to the second.

A design is said to be orthogonal when it satisfies the balance between attributes, levels and when all parameters can be accurately estimated. The design may be too large to respondents to answer, in this case, we use the ***blocking technique*** or design to divide the full design into smaller designs to make answering easier.

4.5.5 Efficient Designs

This design is new and less used due to the need for source data and statistical support software. Efficient designs, unlike orthogonal designs, not only show the correlation between data in order to make predictions but aims to generate parameters going to minimize the error standards. Saracchi (2012) said that an orthogonal design is only efficient in cases where the parameters are not known.

Among the efficient designs, we also have Bayesian design, with the Bayesian design efficiency of a design is evaluated through different configurations coming from the distributions of the parameters.

In conclusion, it is possible to say that if you have information about the parameters it is recommended to use an efficient design, this is because these designs uses parameters to optimize the design where most of the parameters is obtained from each situation of choice, otherwise in the absence of data, it is appropriate to use an orthogonal design.

4.5.6 The Choice Experiment with Stated Preferences

Once the objective to be analysed has been defined and especially the type of analysis to be adopted (choice experiments via "face to face" questionnaires and via the internet), we proceeded to an initial review of the literature, going to select the attributes used in similar research. After searching relevant literature 20 attributes for demand and 23 attributes for supply was seen, the attributes we latter ranked based on number of appearances in literature, which narrowed the attributes to 10 for supply and 10 for demand, it was then presented to a focus group discussed extensively also asked them so we know if what they want is what we found in the literature. The attributes were reduced to 5 each with 2 levels each. It was later reduced to 4 each for demand and supply because the 5^{TH} attribute that is insurance was already a service provided by crowd shipping service and also at had weight to the extent that consumers are not willing to use the crowd shipping if it is not insured, also people were not willing to act as crowd shippers if insurance was not in place no one wanted to bear the cost of damaged goods.

We ended up with 4 attributes for demand and 4 for supply with 2 levels for each attribute.

4.5.7 Design Realization

After the attributes and levels have determined, the design to be used is formulated. The number of attributes and levels increases exponentially when developing the design. The number of alternatives generated by the full factorial will be considered when determining the choice sets that will be presented to the interviewees because the questionnaire contained a total of 19 questions; it was best to submit 3 choice sets per individual.

Bayesian D Optimal design is a part of the efficient designs and it was adopted in the design generation. It is based on the probability of choosing between 2 or more alternatives and aims

to maximize the expected value of a parameter by maximizing the total utility. This is the probability of choosing the alternative that is exactly what the individual stated to choose.

The Bayesian experimental project is based on the Bayesian conclusion to interpret the data acquired during the pilot study. This helps to take include both previous studies of the parameters to be determined and the uncertainties in the observations.

The D-optimality criterion is based on minimizing the determinant of the covariance matrix of the model's coefficient estimates. As a result, this evaluates the effect that each attribute has on the total utility.

This type of criterion best the cases below

- Pilot studies;
- Projects that aim to estimate the effects of attributes on utility and identify

The Bayesian information criterion is based on optimizing the logarithm of the determinant of the information matrix of the highest likelihood of parameter estimators in the multinomial logit model.

The coefficient estimation then uses the method of maximum likelihood, which is defined as follows:

$$L(\beta, \theta) = \prod_{i=1}^{n} p_j^i(i)(v_j^i, (x_j^i, \beta)\theta)$$

The Choice Design platform maximizes the probability of choice over a sample of parameter vectors derived from the previous probability distribution (Kessels et al. 2011).

Probability is defined through a multinomial logit structure below:

$$p_{ij} = \frac{\exp\left(\Sigma_k \beta_k * X_k\right)}{\sum_1^m \exp(\sum_k \beta_k * X_k)}$$

Where:

i & j represents the individual and the alternative

k represents the set of attributes

m represents the set of alternatives

This type of drawing, compared to the orthogonal ones, in addition to minimizing the correlation aims to generate parameters by minimizing the standard error.

4.6 Pilot Survey Generation

First, have the attributes and their levels, in this body of work, the levels identified for each attribute have the peculiarity of being objectively one more predominant than the other, in other words we will always have a better level and a worst. Although the influence of the attribute is not known, the prior knowledge of the utility, positive or negative, of the attributes' level turning text fields into the effect system [-1;1]. With this transformation, in addition to having a more readable table, we are able control the balance of the levels and prevent the same level from appearing multiple times within a choice set. Below is a tabular representation of the supply attributes and their levels.

Table 4.0: Demand Attributes and Levels

Attributes	**Levels**
Remuneration	• *£3(+)* • *£1(-1)*
Location of lockers	• *Inside the metro stations/stops (+)* • *Outside the metro stations/bus stop (-1)*
Bank crediting modes	• *Single delivery (+)* • *5 deliveries (-1)*
Pick-up arrangement	• *Without reservation (+)* • *With reservation (-1)*

Below is a tabular representation of the Demand attributes and their levels.

Table 4.1: Supply Attributes and Levels

Attributes	**Levels**
Shipping cost	• *Less (+)* • *Equal (-1)*
Ability to truck delivery	• *Yes (+)* • *No (-1)*
Shipping time	• *Less (+)* • *Equal (-1)*
Probability to plan delivery date	• *Yes (+)* • *No (-1)*

At this juncture, the levels of the attributes are defined in numerical terms, that is, the number of attributes that can change in a choice set, the number of alternatives per choice set, the number of scenarios for each type of questionnaire, the number of basic types of questionnaires and finally the expected number of respondents.

Using full factorial design, that is, the one where all possible combinations of attributes and levels are explicit, the total of the combinations (or alternatives) would have been of 16, that is 2^4 However, within these 16 combinations there will be some unusable combination, It is therefore justified to reduce the number of combinations with an efficient model , however at the same time it is good not to reduce too much the number of combinations because the software may not be able to generate a balanced efficient data. If the combinations are reduced too much, the side effects will result to inefficient result, the combinations covered two third of the entire combinations.

It was decided to generate 4 blocks with 3 choice sets in each block, the number of respondents for the pilot study was 4 sets adding up to 16 individuals

The next step is to associate the choice to binary system, that is 1 (alternative chosen) or 0 (alternative not chosen).

Below is a table showing the attributes and all blocks for demand.

Table 4.2: Demand Attributes and Blocks

BLOCKS	SCENARIOS	SHIPPING COST	SHIPPING TIME	ABILITY TO TRACK DELIVERIES	POSSIBILITY TO PLAN DELIVERY TIME AND DATE
BLOCK 1	1	-1	-1	1	1
		1	1	-1	-1
	2	1	-1	-1	1
		-1	1	1	-1
	3	-1	1	1	1
		1	-1	-1	-1
BLOCK 2	4	1	-1	-1	1
		-1	1	1	-1
	5	1	-1	1	-1
		-1	1	-1	1
	6	-1	-1	1	-1
		1	1	-1	1
BLOCK 3	7	1	-1	-1	1
		-1	1	1	-1
	8	1	-1	-1	-1
		-1	1	1	1
	9	-1	-1	1	1
		1	1	-1	-1
BLOCK 4	10	1	-1	1	-1
		-1	1	-1	1
	11	1	1	-1	-1
		-1	-1	1	1
	12	-1	1	-1	1
		1	-1	1	-1

Table 4.3: Supply Attributes and Blocks

BLOCKS	SCENARIOS	LOCATION OF LOCKERS	REMUNERATION	PICKUP ARRANGEMENT	BANK CREDITING MODES
BLOCK 1	1	-1	-1	1	1
		1	1	-1	-1
	2	1	1	1	-1
		-1	-1	-1	1
	3	-1	1	1	1
		1	-1	-1	-1
BLOCK 2	4	-1	1	-1	1
		1	-1	1	-1
	5	-1	-1	1	1
		1	1	-1	-1
	6	-1	-1	1	-1
		1	1	-1	1
BLOCK 3	7	-1	-1	1	1
		1	1	-1	-1
	8	1	-1	1	-1
		-1	1	-1	1
	9	-1	-1	1	-1
		1	1	-1	1
BLOCK 4	10	-1	1	1	-1
		1	-1	-1	1
	11	1	-1	-1	1
		-1	1	1	-1
	12	-1	1	-1	1
		1	-1	1	-1

4.6.1 Pilot Survey Analysis (Validity and Reliability)

Once the interviews are provided and the preference data is collected, you can run the model. In order to be sure that the data is valid and reliable, it is important to do this when collecting data using conducting or critiquing research (Heale & Twycross, 2015).

Validity is defined as *"the extent to which a concept is accurately measured in a quantitative study"* (Heale & Twycross, 2015).

In this body of work, the survey is designed to understand consumer preferences of crowd shipping services, we measure the consumer utility and choice. Enlisted are major types of validity explained by Heale and Twycross (2015):

1. *Content validity*:
2. *Construct validity*
3. *Criterion validity*:

The first category is content validity. This category explains if the all the instruments actually measure what they have to in respect to the variables, A technique to evaluate content validity is face validity, here the researcher asks respondents whether the various instruments actually measures what it has to measure (Heale & Twycross, 2015). In this study we piloted the questionnaire face to face, and through focus group to ask and discuss if the instruments being used makes sense and will achieve the said purpose.

Construct validity means can one infer that the variables are related to the concept being studied.

Similar researches have been done in this field using stated preference and the same attributes and levels , this was done by (Gatta, el al 2019) with the topic "Public transport-based crowd shipping for sustainable city logistics: Assessing economic and environmental impacts" there we adopted the method since we had the same topic.

We also used criterion validity to measure the validity. "The extent to which a research instrument is related to other instruments that measure the same variables" (Peiling Zhang and Tingting Li 2018), Correlation is commonly used to determine how the various variables relate with each other.

Below is a correlation table showing how both variables relate with each other for the demand side, using SPSS 24.

Table 4.4: Correlation of Demand Attributes

	Shipping cost	Shipping time	Tracked	Planned
Shipping cost	1.000	0.736	0.814	0.755
Shipping time	0.736	1. 000	0.752	0.713
Tracked	0.814	0.752	1.000	0.732
Planned	0.756	0.713	0.732	1.000

Below is a correlation table showing how both variables relate with each other for the supply side, Using SPSS 24.

Table 4.4: Correlation of Supply Attributes

	Location	Remuneration	pickup	bank
Location	1.000	0.496	0.487	0.592
Remuneration	0.496	1.000	0.388	0.239
Pickup arrangement	0.487	0.388	1.000	0.597
Bank credit modes	0.592	0.239	0.597	1.000

Reliability is tested to know *"whether your data collection techniques and analytic procedures would produce consistent findings if they were repeated on another occasion or if they were replicated by a different researcher"* (Saunders et al., 2012).

Reliability is done to know the consistency of the measure, using the same method to collect data on a different day or time it should have the similar outcome.

In this is body of work, the reliability for this data was determined using SPSS 24. Correlation was used to determine the reliability, in correlation, the figure is displayed between 0 and 1, and the closer it is to 1 the more reliable it is, from the correlation tables above it is evident that the data is reliable.

4.7 Econometric Methodology

The research uses a methodological approach that is based on disaggregated behavioural patterns, this approach expressly describes the behaviour of each individual user through mathematical models of random utility.

Random utility models allow one to represent how a user react or behave when he or she is given a set of alternatives.

This story states that;

- the individual is a rational human who seeks in his choice to maximize his level of satisfaction;
- you know all the alternatives at your disposal;
- the set of available alternatives is different from individual to individual;
- the user associates with each available alternative a utility that he derives from his choice;

- the level of utility is obtained as a combination of various attributes, weighed according to the contribution that each of them makes to the total utility
- the user chooses the alternative to that gives him or her the highest value, the concept of utility is a theory that consists of associating a value of satisfaction with a particular good/service (Louviere et al., 2000). The basic hypothesis is that the utility of an alternative can be measured quantitatively, depending on the attributes that characterize it, by means of a scalar that defines a single function goal.

According to the random utility models the user is rational or chooses the alternative to maximum utility ***(U)***, so user ***(q)*** will choose the alternative ***(j)*** if and only if it, compared to any other alternative ***(i)*** (with the j) belonging to its set of choice, will meet the following inequality:

$$U_{qj} \geq U_{qi} \; \forall \; i \mid A_i \in \bar{A}(q), \; i \neq j \quad \textbf{(1.1)}$$

Where, $\bar{A}(q)=\{A1,\ldots,Aj,\ldots,AM\}$, represents the choice set of the user **(q)** for , $j=1\ldots M, q \in Q$ set of users $\bar{A}(q) \in \bar{A}$ and a set of all the alternatives to be analysed.

The concept of rationality is used to describe a quantified decision-making process (Varian, 1993).Utility is not a deterministic value, that is, it is not known how much the utility that each of us associates with the individual alternatives, therefore, it can be deduced that user behaviour is not perfectly rational (Tversky, 1972) and therefore utility is treated as a stochastic variable or as a random variable, hence another definition of behavioural models which is therefore that of random utility models.

It is noted that,

- An individual faced with the same situation at two different times does not always make the same decision;
- Two people with the same sociodemographic characteristics make different choices;
- The modeler is not able to reproduce exactly the usefulness perceived by the decision maker because trivially may not know with certainty all the peculiarities that affect the choice nor does it have the confidence about the decision-making mechanism adopted (Manski, 1977; McFadden, 1981).

Given the random nature of the utility function, it is not possible to be certain of the alternative chosen by the user but only the probability that the individual makes a certain choice; the behavioural models are in fact probabilistic models and provide the probability that the user ***(q)*** chooses the alternative ***(j)***, and therefore the probability that the alternative ***(j)*** provides the user ***(q)*** with a greater utility than all the other alternatives available to the user. Formally probabilistic models can be written as follows,

$$P_{qi} = prob(U_{qj} \geq U_{qi}) \; \forall \; i \mid A_i \in \bar{A}(q), i \neq j \quad \textbf{(1.2)}$$

In order to make the mathematical model operational, it is necessary to define a mathematical form of the utility function that can reproduce the respondent's behaviour. As indicated by Lancaster (1966), the alternative does not produce any utility. The user, in fact, evaluates the alternative according to all the attributes that make it up and that produce a certain degree of satisfaction. It is typically assumed that utility is represented by two components:

- a systematic component, which is a function of the attributes and alternative and the socio-economic characteristics of the decision-maker;
- an additive component of a stochastic nature that represents the set of non-observable variables of the utility function or any effects of the individual that do not perfectly reflect the theory behavioural patterns that underlies these patterns.

This Utility is expressed as;

$$U_{qj} = V_{qj} + \varepsilon_{qj} \quad \textbf{(1.3)}$$

Where:

$Vqj = f(Xqj, \beta)$ is the deterministic component, called a *systematic utility* and in its linear forms takes the following form,

$$v_j^{iq} = \sum_k \left(\beta_k * x_{j,k}^q\right) + CSA_j * ASA_J$$

Where;

$\underline{Xqj}$ is a vector of measurable attributes (x_{qj}), represented by the characteristics of the service level of the alternative ***(j)*** and the socio-economic characteristics of user ***(q)***;

(β) is a vector of unknown parameters (to be estimated) that represent the weight of attributes on the perceived level of usefulness

ε_{qj} is the random component, also called *haphazard residue*

The systematic utility ***(V)*** of alternative ***(j)*** by the user ***(q)*** is equal to the summation of the number of attributes ***(K)*** of the product of the coefficients ***(β_k)*** for the attributes $x_{j,k}^{q}$.
The relativity of an attribute to an individual will be random depending on how the individual perceives the attribute.

The coefficient defines the weight of the attribute, it can be a positive or negative value depending on whether the attribute represents a utility or does not, in addition it has the function of homogenizing the entire function ,in view of this, its units of measure are the inverse of the units of measure of the attributes considered. In systematic utilities there may be another term defined as the alternative-specific coefficient ***j*** (CSAj) which is multiplied by the specific attribute of the alternative ***j*** (ASAj). In particular, the ASAj is worth 1 if the usefulness we are talking about is precisely the systematic usefulness of the alternative j otherwise zero.

The CSA is introduced in order to describe the systematic usefulness of choosing the alternative ***j*** which is not representable through attributes and thus provides support to the designer in reproducing the phenomenon.
It is essential to point out that the hypothesis of breaking down the utility into a deterministic part and a haphazard component is a particularly useful hypothesis in order to derive the models of discreet choice.
Replacing the equation (1.3) in the equation (1.2) means that the probability of the user having a certain choice can be expressed as:

$$P_{qj} = prob\,(V_{qj} + \varepsilon_{qj} \geq V_{qi} + \varepsilon_{qi}) \quad (1.4)$$

$$P_{qj} = prob\,(V_{qj} - V_{qi} \geq \varepsilon_{qi} - \varepsilon_{qj}) \quad (1.5)$$

From the expression, the analyst knows the difference in the systematic utility (V_{qj} - V_{qi}) but ignores the value $\underline{\varepsilon_q}$ of the random variables vector, hence the value probability is given as

$$P_{qj} = \int_{RN} f(\underline{\varepsilon_q}) d\underline{\varepsilon_q} \quad (1.6)$$

Where the integration R_N is defined as:

$$R_N = \begin{cases} \varepsilon_{qi} \leq \varepsilon_{qj} + v_{qj} - v_{qi} \\ v_{qj+}\varepsilon_{qi} \geq 0 \end{cases} \forall i | A_i \epsilon \bar{A}(q), con\ i \neq j \quad (1.7)$$

The different Models of Discreet Choice used in practice are obtained from different hypotheses related to the distribution random variables.
Eventually, the models that were used for this thesis work will be analysed using the Logit Multinomial Model (MNL) and the Logit Mixed (ML) model.

4.7.1 The Logit Multinomial Model (MNL)

The choice model that can be used depends on the assumptions you make about the distribution of the stochastic part of the utility function, namely the error distribution or function.

The multinomial logit model has a choice structure of multiple alternatives, each of which must be independent of the others, this implies that the alternatives should not be related to each other.

Both the utility and the random residue are associated with a probability density function due to the stochastic variables; this function is for each ε distributed according to a particular function (a Gumbel of a certain parameter is θ)

The term Gumbel identifies the shape of the distribution while the parameter θ provides information on the variance of the distribution, which is, how much of the probability density function is an average value.

If we assume that each random residue ε is independent and identically distributed (IID) the density function $f(\varepsilon)$ can be broken down in the product of ***(N)*** independent functions as;

$f(\varepsilon_1,\dots,\varepsilon_j,\dots,\varepsilon_N) = \prod_{j=1}^{N} g(\varepsilon_j)$ (1.8)

Where $\boldsymbol{g(\varepsilon_j)}$ is the utility distribution associated with the single alternative, and the probability of choice probability of the alternative ***j***, where the individual **q** is obtained as:

$$p_j = \int_{-\infty}^{+\infty} g(\varepsilon_j)\left[\prod_{i\neq j}\int_{-\infty}^{\varepsilon_j+v_j-v_i} g(\varepsilon_i)d_{\varepsilon i}\right] d_{\varepsilon j} \quad (1.9)$$

where the expression:

$$G(\varepsilon_j + v_j - v_i)\int_{-\infty}^{\varepsilon_i+v_j-v_i} g(\varepsilon_i)d\varepsilon_i \quad (1.10)$$

represents the cumulative function of the probability.

An important property of the Gumbel variable is that defined as stability over maximization, that is, the maximum of independent and equal-parameter θ Gumbel variables is still a variable Gumbel's parameter θ

The characteristics mentioned above make the Gumbel variable a particularly convenient hypothesis for the distribution of residues in random utility models, as they express the likelihood of choice of an alternative such as the probability that the perceived usefulness for such an alternative is the maximum of all available alternatives. The use of the Gumbel distribution offers the advantage that the density function has a defined integral and, because of this, the probability has a closed form.

This is indicated with $h(\varepsilon_i) = e^{-\lambda \varepsilon i}$ and with $h'(\varepsilon i) = \partial h(\varepsilon i)/\partial \varepsilon i$ the Gumbel density function is represented as :

$g(\varepsilon_i) = -h'(\varepsilon_i)e^{h(\varepsilon i)}$ (1.11)

the integral of representation is

$$G(\varepsilon_j + v_j - v_i = \left(e^{-h(\varepsilon_i)}\right)_{-\infty}^{\varepsilon_j + v_j - v_i} \quad (1.12)$$

Replacing the value of ***G*** calculated in the probability expression (1.9), and taking into account that in function ***G*** the expression b is independent of and ***j***, you get:

$$p_j = \int_{-\infty}^{+\infty} -h`(\varepsilon_i)e^{-(b+1)h(\varepsilon_j)}d\varepsilon j \quad (1.13)$$

After resolution you get the expression of the MNL:

$$p_j = \frac{e^{\lambda v}qj}{\sum_i^N e^{\lambda v}qi} \quad (1.14)$$

Where; N represents the available alternatives, belonging to the choice set ***A(q)*** of the individual***(q)*** , and $\boldsymbol{\lambda}$ is a variable on which the variance of residues depends on . In the binary logit model, the probability of the alternative ***j*** being chosen by the individual ***n*** is therefore equal to:

$$P_n(j) = \frac{1}{1 + e^{\lambda((\beta' x_{qj} - \beta' x_{qi})}} = \frac{e^{\lambda(\beta' x_{qj}}}{e^{\lambda(\beta' x_{qj} + \beta' x_{qi})}} \quad (1.15)$$

where $\boldsymbol{\beta'}$ is the transposed vector of the parameters and ***X*** is the vector of the attributes.

It is important to note that the density function of the Gumbel is defined less one parameter (λ) and a position parameter (η).

Due to this, the distribution function is equal to:

$F(\varepsilon_j) = \exp[-e^{-\lambda(\varepsilon j-\eta)}]$ (1.16)

Where:

η is fashion, which is supposed for zero convenience

$\eta+\frac{\gamma}{\lambda}$ is the mean/ average, also assumed to be zero;

γ =0.577 is Euler's constant;

λ =is a scale parameter defined as positive;

$\vartheta^2=\pi^2/6\lambda^2$ is the variance.

For this reason, the scale parameter of the Logit model (λ) is the scale parade of the Gumbel distribution and depends on the variance of the residues.

The dependency that binds the parameter λ to the variance θ allows you to rewrite the equation (1.14) in the following most common form:

$$p_j = \frac{e^{\frac{v_{qj}}{\theta}}}{\sum_i^N e^{\frac{v_{qj}}{\theta}}} \quad (1.17)$$

It should also be remembered that in the estimation of the Logit model, the parameter θ is incognito and will have to be calibrated from real data.

Therefore, if the haphazard residues are very dispersed compared to the average, the parameter θ tends to infinity and the alternatives tend to become equiprobable. In practice, high variance values (due to a poor specification of the systematic utility function and/or incorrect assumptions about the distribution of residues) reduce the effect of the difference in attributes $(V_{qj} - V_{qi})$ on the probability of choosing alternatives and lead to incorrect predictions of parameters. Otherwise, that is, when variance tends to zero, dispersion tends to be nothing whereby utilities are equal only ***v*** systematic utilities. In this situation the alternative with the most systematic utility is the one that is chosen, and the stochastic model becomes deterministic, that is, you will have an alternative with probability 1 and an alternative with probability 0.

The MNL is the simplest Discreet Choice Model but also the most used. The main advantage of the MNL lies in the possibility of expressing in closed form the full probability of choosing the generic alternative, which makes it very simple to process computationally.

There are three essential aspects to the random residues with the MLN:

- the absence of correlation between the alternatives;
- variance equals all alternatives: that is, the MNL model is homoscedastic;
- homogeneity in user preferences for attributes and alternatives;

In the multinomial logit model, the variance/covariance array has the following characteristics:

- covariance is zero because by definition of the model there is no dependency between alternatives;
- variance is tied to the variable θ and is the same for each element of the diagonal., For the definition of the MNL the dispersion with respect to the average value is the same for each alternative as a result of the fact that the distribution is the same.

These aspects lead to an extremely simple variance-covariance matrix that can be traced back to the product between the variance and the identity matrix.

4.7.2 Model Estimation

Model estimation is the process that allows you to estimate the vector parameter by knowing the choices made by respondents. The method of maximum likelihood is used for calibration of disaggregated behavioural demand patterns, while the least squares method is used in regression models. Behavioural patterns provide as output a probability of choice that is a function of the utility that the individual associates with that alternative compared to the total of alternatives available to the user.

The method of maximum likelihood, in statistics, is a procedure for defining an estimator, and for the purposes of the application must be known the function of likelihood, $L(\beta,\theta)$, which expresses the probability of observing the set of choices of the sample users, conditionally to the values assumed by the parameters being estimated.

$$L(\beta,\theta) = \prod_{i=1}^{n} p_j^i(i)(v_j^i, (x_j^i, \beta)\theta$$

The likelihood ***L*** is a probability producer calculated according to the chosen model. The calculation of probabilities depends on the value of the attributes and the coefficients β, which define the systematic utilities, and the vector that defines the characteristics of the model.
The ***P*** probability of the method of maximum likelihood is the probability that the user chooses the alternative ***j*** which is the alternative that he actually chose in reality.

The model must be as much as possible to redefine reality, and therefore the β must be defined θ so that the probability of choosing the actual alternative for each user will approach the θ as much as possible to the unit. As a result, the principle of maximum likelihood is to determine the vector of the parameters that make the function L(β,θ) , the probability of observing the functions of the choices actually made by each user.

In particular, the estimated trailing parameters **β* e θ*** of the model that represent the arguments that maximize the likelihood function are indicated by the value of the model. Usually the natural logarithm of the function of $L(\beta,\theta)$ is studied. In fact, maximizing L or ln(L) is equivalent because both are increasing functions; however, passing to natural logarithms the function of likelihood becomes the summit of natural probability logarithms.

$$inL(\beta,\theta) = In\left(\prod_{i=1}^{n} p_j^i(i)(v_j^i, (x_j^i,\beta)\theta\right) = \sum_{i=1}^{n} p_j^i(i)$$

The maximization of the function of maximum likelihood can be achieved through particular mathematical procedures of operational research, among them the most used are the method of the gradient and Newtonian methods.

4.7.3 Testing Estimated Parameters

Once the parameters have been estimated, it is essential to validate the model by verifying the statistical significance of the measured parameters. The verification phase tests whether the estimated parameter (which is precisely an estimator of the true parameter in the population) differs from a reference value. generally assumed to be zero. Verification can be obtained by:

- *Informal tests;*
- *Formal tests.*

Informal tests allow without special statistical tools to check if the estimated parameter has anomalies. The most used and immediate informal tests include checking the sign of the estimated parameter with the expected one and checking the value that the CSA assumes within the utility within an alternative. In fact, a high value of CSA within the systematic utility in which it is defined, may indicate the attributes used within the alternative are not significant in expressing the utility itself This is expressed exclusively by the CSA.

Among the most used statistics for checking the significance of the estimated attributes we have:

- *Likelihood Ratio Test*

The test of the likelihood ratio allows you to perform a joint test on the entire vector $\underline{\theta}$ of attributes of the model, providing a comparison of the value of the likelihood function at the maximum point ($\underline{\theta}^*$) and the corresponding value in the event of some linear restrictions imposed on model attributes. if we indicate with *r* the number of linear restrictions, and with $\underline{\boldsymbol{\theta r}}^*$ value of the coefficients calibrated in this case, the LR statistic is

$$LR = -2[l(\underline{\theta}_r{}^*) - l(\underline{\theta}^*)]$$

it is atypically distributed according to a $\boldsymbol{\chi 2}$ with $\boldsymbol{r}$ degrees of freedom.

The comparison between the value of the LR statistic and the critical value of the distribution $\boldsymbol{\chi 2}$ per *r* degrees of freedom assigns the level of significance with which the null hypothesis can be rejected expressed by the restrictions. This test is used to know whether to treat an attribute as specific or not (attribute genericity) and to check whether coefficients of a certain model are suitable for two subgroups of users (sample homogeneity).

The Index $\boldsymbol{\rho 2}$

The $\boldsymbol{\rho 2}$ is an index between 0 and 1 that allows us to compare multiple models that may also have a different number of coefficients to estimate. The test is defined as:

$$p^2 = 1 - \frac{lnL(\beta^*, \theta^*}{lnL(0)}$$

The most typical use of this index is in comparison with the equiprobable model (β=0,θ=0). When the index is zero it means that the model offers no explanation of the phenomenon when the index is equal to 1 the model perfectly reproduces the phenomenon.

The value $\rho 2$ also depends on the number of parameters estimated in the model, as the value of the maximum likelihood function decreases the number of parameters increases

To work around this problem, the index $\boldsymbol{\rho \bar{2}}$ which is always calculated against the equiprobable model but corrects the number of parameters to be estimated:

$$\bar{\rho}2 = 1 - \frac{lnL(\beta^*, \theta^*}{lnL(0)}$$

This implies that $\bar{\rho}2 \leq \mathrm{p}2$

- ***The t-test***

The asymptotic test allows you to test the model parameters individually; that is, it allows you to check how much each estimated parameter differs from a given constant value, often

assumed to zero. The test is valid only asymptotically and that is for numerous samples, for which it is shown that the statistic:

$$t = \frac{\beta_k^* - \beta_k}{\sqrt{var\beta^*}}$$

is distributed according to Standard Normal *N(0.1)*. The test provides the level of significance to which it is possible to reject the null hypothesis that each parameter individually equals a certain value, often zero (βk=0) this hypothesis is rejected at a 95% confidence level if the value of ***t*** is greater than 1.96.

In addition to the above tests you also need to check the correlation and covariance of the estimated attributes and parameters, and to have a more accurate model there are additional tests that compare the simulated model with the real data. In particular, the latter type of test allows the modeler to detect the presence of errors and their magnitude.

Chapter 5

5.0 Empirical Findings

5.1 The Survey Questionnaire

The survey questionnaire is the measurement tool designed to collect information on the qualitative and quantitative variables being investigated (Gatta et al 2019). It is also a communication tool aimed at facilitating the interaction between the researcher, the respondent. The questionnaire was meant to be administered face to face but due to the Outbreak of the novel Corona Virus (COVID 19) 70 % the of questionnaires were administered online through Google Forms, email, zoom and skype video calls.

5.1.1 Description of the Questionnaire

The operations that lead to the definition of the questionnaire are:

- *Defining goals*

It is important to define exactly what the main variables that are of interest. A provisional plan of statistical analyses is then prepared to ensure that the content needed for the study is well expressed.

- *Drafting the questionnaire*

The questionnaire is arranged logically according to the research objectives, all the questions followed a sequence and answer the research questions.

- *Questionnaire verification*

This is the final phase and it is very important this is done; the supervisor for this thesis went through and approved it, a pilot study is then conducted to be sure the questionnaire is valid.
The questionnaire is structured nicely and not many questionnaires on one page, so the respondents are not overwhelmed by the number of questions seen per page. Also, questions that are sensitive like the income level were placed last, so it does not put the respondent off at the beginning of the questionnaire or middle, this avoid high rates of unfinished data and improves validity.
For this thesis, two different questionnaires were distributed, the first was the (demand) that is, people willing to purchase the crowd shipping service and (supply) people willing to act as crowd shippers.

The first part of the questionnaire for both demand and supply had the Pre interview phase, which entailed the online purchasing habit, posting habit and the knowledge the respondent has about crowd shipping(demand). The Pre-interview phase for supply entailed the respondents purpose of frequent trips, time of trips and how trips are often taken , The second part had the choice scenarios which investigated attributes that affect people's decision to act as crowd-shipper (supply) and attributes that would make people be willing to purchase crowd shipping (Demand) service.

The next phase was Likert questions, investigating the behaviours of the respondents regarding sustainability. This followed a post interview phase asking the respondent how confident they were that the crowd-shipping service would be successful in both rural and urban areas. Finally, the sociodemographic questions were asked to know the age, gender, educational level and income level of the respondent so we may know the exact demographic of people who would like the service. Due to the sensitive nature of the question, level of income it was placed last.

Respondents were required to be frequent users of the metro in London to act as a crowd-shippers (Supply). In view of this, respondents were specifically asked if they often used the metro and if the respondent does not, he or she is not allowed to respond to the questionnaire, this was to filter the respondent and get only eligible individuals to answer it.

Also, the service of crowd-shipping was described and to which respondents were asked whether they would be interested in acting as shippers or patronize the service before presenting the choice sets. In this way, the individual who proves completely uninterested is prevented from completing the choice sets. However, already filled data is kept for final estimation of records.

5.2 Data Collection

Firstly, data was collected face to face in metro stations in London and libraries in March 2020; however, on enumerating the data collected we encountered some mistakes: the wrong choice sets was shown to the respondents. In that regard, new data had to be collected in April 2020 through the surveys by Google Forms, https://nettskjema.no/ on Molde university website. Also, administration was carried largely through social networks including Facebook, Likened In, zoom etc.

5.3 Data Limitations

Although the results from the survey give new and interesting findings, the sample size for this survey was random, small and skewed towards a youthful population. A more robust sample will aid provide better understanding and insight.

5.4 Descriptive Statistics for Demand and Supply

This data contains the descriptive statics about who answered the questionnaire, the questionnaire had 92 respondents but 9% of this data collected representing 8 individuals did not meet the criteria for compilation so they were not added, reducing the totally compiled data to 84 respondents for both demand and supply (84 demand and 84 supply), the data shown below, represents both demand and supply since the same respondents answered the two questionnaires.

Table 5.0: Gender of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	43	51.2	51.2	51.2
	female	39	46.4	46.4	97.6
	others	2	2.4	2.4	100.0
	Total	84	100.0	100.0	

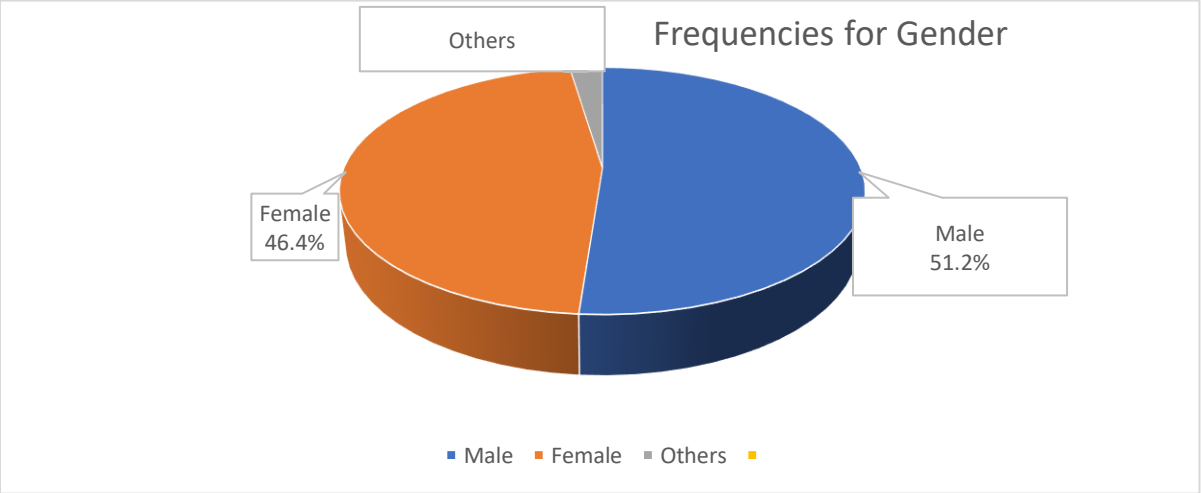


Figure 5.1: Gender Frequency Pie Chart

As it can be seen in the pie chat and table above 51.2 % of the respondents were male, 46.4% were female and 2.4 % decided not to disclose their gender.

Table 5.1: Age of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15 to 25	23	27.4	27.4	27.4
	25 to 45	42	50.0	50.0	77.4
	46 to 65	15	17.9	17.9	95.2
	66 to 80	3	3.6	3.6	98.8
	81 and above	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

The age of the respondent was vastly youth between the age 15 to 45 years representing 77.4% of the entire respondents.

Table 5.2: Educational Level of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High school	23	27.4	27.4	27.4
	Undergraduate	44	52.4	52.4	79.8
	Postgraduate	16	19.0	19.0	98.8
	PHD/ Professor	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

Majority of the respondents were undergraduate degree holders representing 52.4% followed by high school graduates and post graduate degree holders.

Table 5.3: Occupation of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Employed fulltime	70	83.3	83.3	83.3
	Employed part-time	3	3.6	3.6	86.9
	student	6	7.1	7.1	94.0
	Student with part-time job	5	6.0	6.0	100.0
	Total	84	100.0	100.0	

Unemployed, retired and prefer not to answer were additional alternatives given but respondents. Nonetheless, no respondents were found in those categories, reason why they are not represented on the table above. Form the data collected, 83% of the respondents were fulltime employees, 7.1 % were students without jobs, 6% were students with part-time jobs and 3% of the respondents were employed part-time.

Table 5.4: Income Level of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5,000 pounds	5	6.0	6.0	6.0
	Between 5,001 and 10,000 pounds	5	6.0	6.0	11.9
	Between 10,001 and 20,000 pounds	9	10.7	10.7	22.6
	Between 20,001 and 30,000 pounds	15	17.9	17.9	40.5
	Between 30,001 and 50,000 pounds	33	39.3	39.3	79.8
	Between 50,001 and 80,000 pounds	14	16.7	16.7	96.4
	More than 80,001 pounds	3	3.6	3.6	100.0
	Total	84	100.0	100.0	

The income level of the respondents correlates with the occupational level and age groupings, since majority of the respondents were youths and employed, 62% of the respondents earned more than 20,000 pounds per annum.

The attitude of respondents toward sustainability was measured by asking them the relevant questions below.

Table 5.5: Sustainability Behaviour of Respondents

I am very keen on hearing about environmental issue
I happen to collect waste present in parks/beaches/roads even it is left by others
I sign petitions for environmental protection
I prefer to use less polluting means of transport than cars
I direct my choices towards sustainable eco-friendly products and services

I happen to use sharing services (car sharing, Airbnb, Uber etc...)

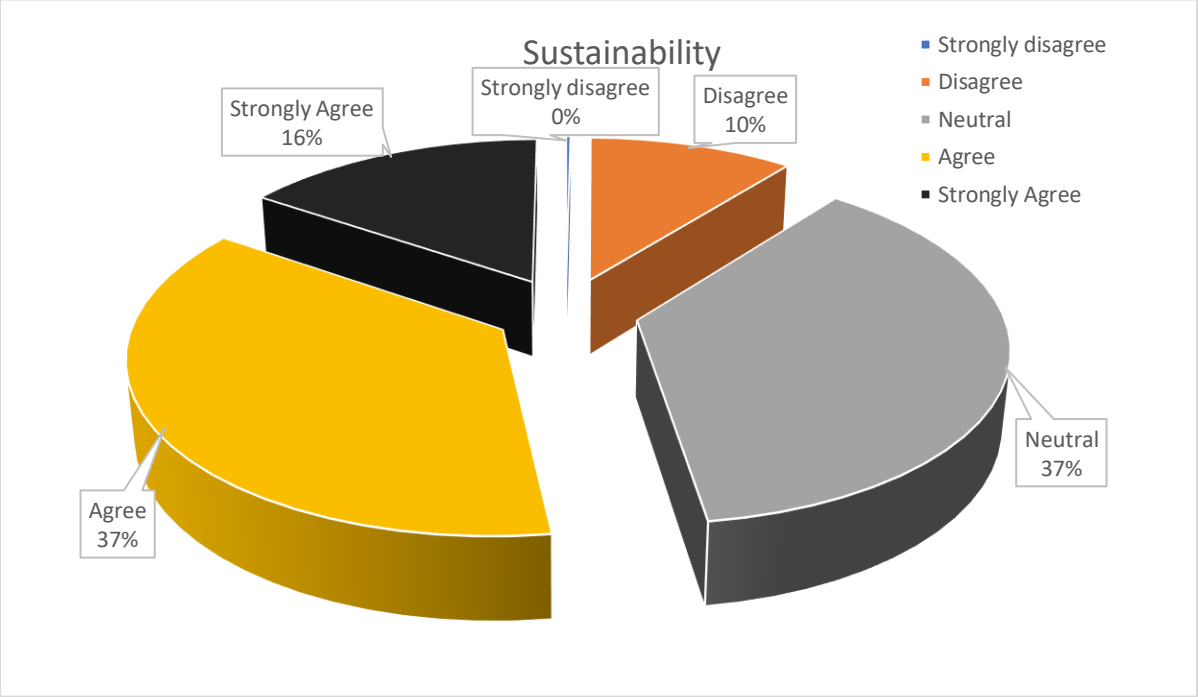


Figure 5.2: Sustainability Pie Chart

The pie chart above shows the respondents' attitude towards sustainability; 10% show little concern for sustainability, 37 % are neutral, meaning they are indifferent towards sustainability, 37% have higher concern for sustainability and 16 % were extremely environmentally conscious meaning they have highest concern for sustainability.

Respondents were asked how confident they were that crowd-shipping service would be successful in the cities (or urban area and beyond), below are the questions asked and the data collected.

13) How confident are you that this service can be successful?

1 10%

2 25%

3 50%

4 75%

5 90%

Table 5.6: Success Rate of Service in Urban Areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3(50%)	29	34.5	34.5	34.5
	4(75%)	35	41.7	41.7	76.2
	5(90%)	20	23.8	23.8	100.0
	Total	84	100.0	100.0	

The table above indicates a positive reaction with none of the respondents expressing no confidence in the successes of the service; 34.5% of the respondent where somewhat confident (50% sure) , 41.7% were confident that it was going to be successful(75% sure) and 23.8 were very confident it was going to be successful(90% sure). This data shows that, generally the respondents were confident that the service would be successful.

14) How confident are you that this service can be extended beyond the urban environment?

1 10%

2 25%

3 50%

4 75%

5 90%

Table 5.7: Confidence Level for Extension of Service

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(10%)	3	3.6	3.6	3.6
	2(25%)	42	50.0	50.0	53.6
	3(50%)	33	39.3	39.3	92.9
	4(75%)	5	6.0	6.0	98.8
	5(90%)	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

Respondents who were 90% confident that this service could be extended beyond urban areas account for only 1.2%, respondents who expressed 75% confidence were 6%, with 39.3% of respondents expressing the indifference in the 50% region. Also, 53.6% were not confident (25% and below). Average respondents were not confident that this was going to be successful beyond urban areas.

The table below illustrates data collected after asking respondents whether they knew and had patronized the crowd-shipping shipping service.

Table 5.8: Respondents Who Have Heard About Crowd Shipping

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(Yes)	28	33.3	33.3	33.3
	2(No)	56	66.7	66.7	100.0
	Total	84	100.0	100.0	

Table 5.9: Respondents Who Have Patronized Crowd-Shipping Service

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(Yes)	11	13.1	13.1	13.1
	2(No)	73	86.9	86.9	100.0
	Total	84	100.0	100.0	

Table 5.10: Patronized Companies

		Frequency	Percent	Valid Percent
Valid	0 (have not patronized)	73	86.9	8.3
	1 (Nimber)	7	8.9	8.3
	2 (Peggy Bee)	1	1.5	1.2
	3 (Living Packets)	3	2.7	2.4
	Total	84	100.0	100.0

Table 5.11: Patronized by Sending or Buying

		Frequency	Percent	Valid Percent
Valid	Do not know	73	86.9	86.9
	1 (send)	6	7.1	7.1
	2(receive)	5	6.0	6.0
	Total	84	100.0	100.0

Respondents were asked if they had heard of crowd-shipping and if yes, whether they had patronized the service and which company they patronized, 33.3% of the respondents had heard of crowd-shipping before, 13.1 % had patronized crowd-shipping service , 8.9 % of the population patronized Nimber services, 2.7% patronized Living Packets service and 1.5 percent

patronized the service of PeggyBee. 7.1% was for sending and 6.0% was from receiving parcels through crowd-shipping service

5.4.1 Demand Side

The responds of the survey were asked specific questions to know if they are willing to patronize the crowd-shipping service and their buying behaviour, below are the questions and data accumulated.

How often do you buy small/medium-sized goods over the internet?

1.Rarely or never

2.few times a year

3.Once a month

4.Two or three times a month

5.Once or twice a week

6.At least three times a week

Table 5.12: Purchasing Frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(rarely or never)	5	6.0	6.0	6.0
	2(few times in a year)	3	3.6	3.6	9.5
	3(once a month)	13	15.5	15.5	25.0
	4(two or three times a month)	20	23.8	23.8	48.8
	5(once or twice a week)	25	29.8	29.8	78.6
	6(At least three times a week)	18	21.4	21.4	100.0
	Total	84	100.0	100.0	

From the table above 6% of the respondents rarely buy over the internet, 3.6% of the respondents sometimes buy a year over the internet, 15.5% of the respondents buy once a month over the internet, 75 % of the respondents buy over the internet for at least two to three times a week. Averagely the respondents often buy goods over the internet.

How often do you buy small/medium-sized goods over the internet?

1.Rarely or never

2.few times a year

3.Once a month

4.Two or three times a month

5.Once or twice a week

6.At least three times a week

Table 5.13: Courier Usage Frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 (rarely or never)	17	20.2	20.2	20.2
	2(few times a year)	35	41.7	41.7	61.9
	3 (once a month)	17	20.2	20.2	82.1
	4 (two or three times a month)	7	8.3	8.3	90.5
	5 (once or three times a month)	7	8.3	8.3	98.8
	6 (At least three times a week)	1	1.2	1.2	100.0
	Total	504	100.0	100.0	

From the table above, respondent did not often post small/medium goods through courier service, 82.1% of the respondents post small or medium goods at most once a month or less and this averagely indicating that most of the respondents do not often post small or medium goods through courier service.

If you accept this mode of transport what will be the most preferred time that you will like your item to be delivered?

1.Morning before 12 pm

2. Afternoon before 17 pm

3. Evening before 10pm

4.Night before 6am

5.Morning and evening

6.Morning and afternoon

7.Morning afternoon and evening

8.Indifferent

Table 5.14: Acceptable Parcel Delivery Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(morning before 12)	1	1.2	1.2	1.2
	2(afternoon before17)	11	13.1	13.1	14.3
	3(evening before 10pm)	11	13.1	13.1	27.4
	4(night before 6am)	1	1.2	1.2	28.6
	5 (morning and evening)	8	9.5	9.5	38.1
	6(morning and afternoon)	19	22.4	22.4	60.5
	7(morning, afternoon and evening)	13	15.5	15.5	76.0
	8(indifferent)	20	24.0	24.0	100.0
	Total	84	100.0	100.0	

Respondents were asked the preferred time that they would prefer to receive their packages or parcels,1.2% preferred to receive their package morning before 12, 13.1% preferred afternoon before 17pm and 13.1% preferred evening before 22 pm , 1.2% preferred night before 6am, 9.5% preferred morning and evening, 22.4% preferred morning and afternoon, 15.5% preferred morning, afternoon and evening , 24% were indifferent about when they want to receive their package.

In the event that your parcel is being delivered what is the maximum length you are willing to travel for your parcel?

1 0 meters (Home/ Work place)
2 0-300 meters
3 300-600 meters
4 600-1200 meters
5 more than 1200 meters

Table 5.15: Extra Distance to Cover

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(0 meters)	38	45.2	45.2	45.2
	2 (1 to 300 meters)	33	39.3	39.3	84.5
	3 (301 to 600 meters)	11	13.1	13.1	97.6
	4 (601 to 1200 meters)	2	2.4	2.4	100.0
	Total	84	100.0	100.0	

Respondents were asked the distance they are willing to take to receive their packages,45.2% preferred to receive their parcel at home or work, 39.3% were willing to go an extra 1 to 300 meters for their parcels, 13.1% of the respondent were willing to go 301 to 600 meters, 2.4% of the respondent were willing to detour 601 to 1200 meters. No one was willing to go more than 1200 meters for their package.

How long will you prefer that your parcel will take before its delivered?

1 Less than 3 hours
2 From 3 to 6 hours
3 One day
4 Up to 3 days
5 Over 3 days

Table 5.16: Willingness to Wait for Parcel

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2(from 3 to 6 hours)	5	6.0	6.0	6.0
	3 (one day)	36	42.9	42.9	48.8
	4 (up to 3days)	34	40.5	40.5	89.3
	5 (over 3 days)	9	10.7	10.7	100.0
	Total	84	100.0	100.0	

The table above shows how long the respondents are willing to wait to receive their parcels or goods, 42.9% of the respondents preferred to receive their parcels in one day, 40.5% preferred

up to 3 days , then 9% preferred over 3days, 6% preferred to receive their parcel between 3 to 6 hours, no one choose less 3 hours when respondents were asked they replied it was not very realistic to them.

5.4.2 Supply Side

The data below represents the answers given by respondents when they were asked questions relating to willingness to act as a crowd shipper.

Table 5.17: Travel Frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(weekdays)	44	52.4	52.4	52.4
	2 (weekends)	2	2.4	2.4	54.8
	3(weekdays and weekend)	37	44.0	44.0	98.8
	4 others	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

The table above shows that 52.4% travel frequently during the weekdays, 44% travel frequently during weekdays and weekends, 2.4% travel frequently during weekends and 1.2% choose others.

Table 5.18: Purpose of Trip

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 study	17	20.2	20.2	20.2
	2. work	66	78.6	78.6	98.8
	3.freetime	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

The respondents were further asked the purpose of their trips and 78.6% travelled for work ,20.2% travelled for study and 1.2% travelled on their free time.

Table 5.19: Frequently Travel Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(Morning before 12pm)	3	3.6	3.6	3.6
	2(Afternoon before 17)	1	1.2	1.2	4.8
	5 (morning and evening)	45	53.6	53.6	58.3
	6 (morning and afternoon)	32	38.1	38.1	96.4
	7 (morning, afternoon and evening)	3	3.6	3.6	100.0
	Total	84	100.0	100.0	

Respondents were asked the time of the day that they frequently travel, 53.6% travelled often during morning and evenings, 38.1% travelled during morning and afternoon, 3.6% travelled in the morning, afternoon and evening, 3.6% travelled in the morning before 12pm and 1.2 % of the respondents travel in the afternoon after before 17pm.

Travel time (duration): _____ (Indicate the average time it takes

Table 5.20: Travel Time

	N	Minimum	Maximum	Mean	Std. Deviation
duration	84	10.00	120.00	34.7024	17.54887
Valid N (listwise)	84				

The respondents had an average travel time of 35 minutes with a minimum of 10 minutes and a maximum of 2hours.

Table 5.21: Ticket Types Purchased

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(single ticket)	6	7.1	7.1	7.1
	2(daily ticket)	1	1.2	1.2	8.3
	3 (monthly tickets)	46	54.8	54.8	63.1
	4 (yearly tickets)	31	36.9	36.9	100.0
	Total	84	100.0	100.0	

54.8 % of the respondents buy monthly tickets, 36.9% buy yearly tickets, 7.1% buy single tickets (oyster and contactless taps) and 1.2% buy daily tickets.

The picture below shows the image shown to the respondents to ask them on how their travel from their point of origin to destination looks likes.

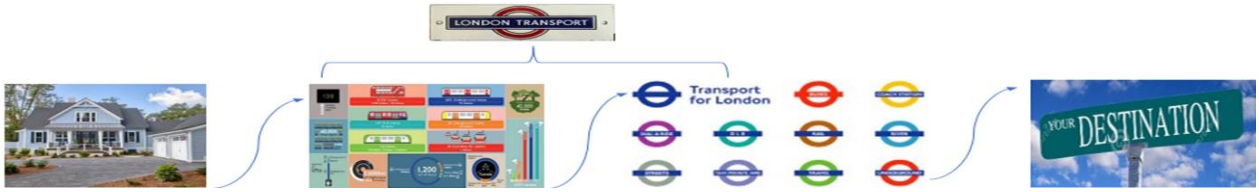


Figure 5.3: Systematic Travel Indication for Respondents

Table 5.22: Travel Origin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 (walking)	40	47.6	47.6	47.6
	2(bicycle)	5	6.0	6.0	53.6
	3 (motorcycle/moped/scooter)	2	2.4	2.4	56.0
	4 (private car)	2	2.4	2.4	58.3
	5(public transport)	22	26.2	26.2	84.5
	6 (taxi/uber)	10	11.9	11.9	96.4
	8(others)	3	3.6	3.6	100.0
	Total	84	100.0	100.0	

Table 5.23: Transit

	Frequency	Percent	Valid Percent	Cumulative Percent
1 (walking)	10	6.0	6.0	6.0
2 (bicycle)	4	4.8	4.8	10.7
5(Public transport)	54	64.3	64.3	75.0
6(taxi/Uber)	20	23.8	23.8	98.8
9 (I do not transit)	1	1.2	1.2	100.0
Total	84	100.0	100.0	

From the data collected, 47% representing majority of the respondents, leave their point of origin by walking, 26.2% by public transport, 11.9% by taxi or uber, 2.4% use motorcycle/scooter/moped, 2.4% use private vehicles and 3.6% travel through other means.

The next table shows how the transit behaviour of the respondents, 64.3% transit through public transport, 23.8% transit through taxi/uber, 6.0% walk, 4.8% use bicycle and 1.2% do not transit at all.

Table 5.24: Distance Travel to Deliver

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1(o meters/ right at the metro station)	42	50.2	50.2	50.2
	2(1 – 300 meters)	31	36.7	36.7	86.9
	3 (301- 600 meters)	9	10.7	10.7	97.6
	4(601- 1200meters)	1	1.2	1.2	98.8
	5(more than 1200 meters)	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

The respondents were asked in the course of delivering , how long they were willing to travel to deliver the package, 50% of the respondents were willing to deliver at the metro station or stops , 36.7% were willing to detour a maximum of 300 meters, 10.7% were willing to detour a maxim of 600 meters and finally 1.2% were willing to go an extra 1200 meters; this means majority of the respondents were willing to deliver right at the metro stations or stops.

Chapter 6

6.0 Results

This chapter presents tables with the results of the estimates made for both the demand and Supply.

The results of the models were obtained by estimating all the attributes and levels of the experiment and adding the sociodemographic and aptitude variables that were significant in the selection process. This technique has improved the overall results and completes the profiling of the service. The estimation process has come in two phases, both based on the approach of maximum likelihood:

1. In the first phase, only the attributes in the scenarios were predicted by using the JMP® software. In order to respect the balance of the blocks provided by the experimental design, the estimate was carried out with the same number of surveys for each of the 4 types of questionnaires administered.

The second phase of the estimation process was carried out through the free software packages BIOGEME introducing sociodemographic and aptitude variables (online purchase frequency, online posting frequency, knowledge on crowd shipping, age and educational level). Since these attributes were not present in the experimental drawings, it was possible to use all the sample present for each type of survey block without any constraint

6.2 Presentation of Results

6.2.1 Demand Results

This section describes the results of the demand side, the model structure adopted consists of 3 alternatives: Option A, Option B, and "No Choice".

Option A and option B represent the unlabelled alternatives offered in the chosen choice sets, while the "No Choice" alternative represents individuals who have not preferred either of the two proposed alternatives.

The utilities used to estimate the model are as follows:

$utility_{Option\ A} = \beta_1 * Shipping\ \text{Cost}_A + \beta_{2*}\ Shipping\ times_A + \beta_{3*}\ Ability\ to\ Track\ deliveries_A + \beta_{4*}\ Possibility\ to\ plan\ deliveries_A$

$\text{utility}_{Option\ B} = \beta_1 * Shipping\ \text{Cost}_B + \beta_{2*}\ Shipping\ times_B + \beta_{3*}\ Ability\ to\ Track\ deliveries_B + \beta_{4*}\ Possibility\ to\ plan\ deliveries_B$

Below will be the results of the estimated models both with the totality of the sample and dividing the same into behavioural subgroups.

Table 6.1: Average Demand Variable Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.60095***	.14675	4.10	.0000
Ability to Track (Yes)	.63745***	.13887	4.59	.0000
Shipping Time (Less)	.62908***	.12775	4.92	.0000
Possibility to Plan deliveries (Yes)	.52138***	.12791	4.08	.0000

***, **, * ==> Significance at 1%, 5%, 10% level.

[a] Respect to other existing delivery services

*base level: "equal costs"; **base level: "No"; ***base level: " equal times "; ****base level: "No".

Table 6.1.1: Demand Model Statistics

Number of observations (individual)	252
Skipped observations	36
Estimation observations	216
Log likelihood function	-126.86596

The above tables show results for the overall sample taken; all the attributes are dummy variables and were significant meaning they have an impact on the dependent variable (choice). The coefficients inform how the various attributes of the service affect the respondent's utility function.

From the coefficients, Ability to track is the most important attribute with (+)0.63745 coefficient variable, meaning the availability of the service ability to track delivery increases the utility of the respondents by 0.63745. Shipping time is next with a coefficient of (+)0.62908, this means the lesser the shipping time, the utility of the respondents is impacted or increases

by 0.62908. shipping cost follows with a coefficient of (+)0.60095, meaning the lesser the shipping cost, the more the utility the respondents achieves, or the respondents' utility will be impacted by (+)0.60095.

The last attributes based on the coefficient is Possibility to Plan deliveries with a coefficient of (+)0.52138, meaning if there is an ability to track delivery the respondent's utility will be increased by 0.52138.

Number of observations 252, but 216 of them was estimated because 36 of the observation was skipped because the software saw them as not fit for use

Presented below are the results of the subsamples as compare to the total sample, these give a good explanation on how specific socio demographics are willing to pay for the crowd-shipping service.

Table 6.2: Frequency of Purchase Sub-sample Demand Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.63812***	.22016	2.90	.0037
Ability to Track (Yes)	.85517***	.22086	3.87	.0001
Shipping Time (Less)	.64704***	.19844	3.26	.0011
Possibility to Plan deliveries (Yes)	.58094***	.19841	2.93	.0034

***, **, * ==> Significance at 1%, 5%, 10% level.

[b] Respect to other existing delivery services

*base level: "equal costs"; **base level: "No"; ***base level: " equal times "; ****base level: "No".

Model Statistics

Table 6.2.1: Sub-sample Demand Model Statistics

Number of observations (individual)	123
Skipped observations	18
Estimation observations	105
Log likelihood function	-58.85048

Respondents were asked how frequent they purchase goods over the internet and were given the options 1) Rarely or never 2) few times in a year 3) Once in a month 4) Two or three times a month 5) Once or twice a week 6) At least three times a week.

Respondents were grouped into two, **(Q2<5), Q2_1=1, (Q2≥5), Q2_1=0,**
the table above represents the respondents who buy online less than once or twice a week. All the coefficients are very significant, meaning there is impact when the attributes increase or decreases and when the attribute(service) is provided or not.

From the coefficients, ability to track is the most important attribute with (+)0.85517 coefficient variable, meaning the availability of the service ability to track delivery increases the utility of the respondents by 0.85517. Shipping time is next with a coefficient of (+)0.64704, this means the lesser the shipping time, the utility of the respondents is impacted or increases by 0.64704. shipping cost follows with a coefficient of (+)0.63812, meaning the lesser the shipping cost, the more the utility the respondents achieves, or the respondents' utility will be impacted by 0.63812 The last attributes based on the coefficient is Possibility to Plan deliveries with a coefficient of (+)0.58094, meaning if there is an ability to track delivery the respondent's utility will be increased by 0.58094.

Generally, all the coefficient of the attributes is greater than that of the average sample (table 6.1), meaning respondents who buys goods over the internet less than once or twice a week have greater impact utility when the attributes are increased or reduced.
Number of observations 123, but 105 of them was estimated because 18 of the observation was skipped because the software saw them as not fit for use.

Table 6.3: Sub-sample Demand Model Statistics

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.60276***	.20347	2.96	.0031
Ability to Track (Yes)	.46571**	.18120	2.57	.0102
Shipping Time (Less)	.64661***	.17213	3.76	.0002
Possibility to Plan deliveries (Yes)	.48863***	.17106	2.86	.0043

***, **, * ==> Significance at 1%, 5%, 10% level. **reject; Q3_1=0**

[c] Respect to other existing delivery services

*base level: "equal costs"; **base level: "No"; ***base level: " equal times "; ****base level: "No".

Table 6.3.1: Sub-sample Demand Model Statistics

Number of observations (individual)	129
Skipped observations	18
Estimation observations	111
Log likelihood function	-65.24527

Table 6.4: Sub-sample Demand Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.66671***	.18983	3.51	.0004
Ability to Track (Yes)	.61876***	.17609	3.51	.0004
Shipping Time (Less)	.67022***	.16493	4.06	.0000
Possibility to Plan deliveries (Yes)	.55964***	.16407	3.41	.0006

***, **, * ==> Significance at 1%, 5%, 10% level.

[d] Respect to other existing delivery services

Table 6.4.1: Sub-sample Demand Model Statistics

Number of observations (individual)	156(52)
Skipped observations	18(6)
Estimation observations	138(46)
Log likelihood function	-79.90179

Respondents were asked how frequent they post goods and were given the options 1) Rarely or never 2) few times in a year3) Once in a month4) Two or three times a month 5) Once or twice a week6) At least three times a week.

Respondents were grouped into two, **(Q3<3) Q3_1=1, (Q3≥5) Q3_1=0**
the table 6.3 above represent the respondents who post goods less than once or twice a week. All the coefficients are very significant, meaning the attributes have a strong impact on utility also can easily be replicated.

Comparing the coefficient to the average sample (Table 6.1), Shipping time is the most important attribute to those who post goods less than once or twice week, with a coefficient of (+)0.64661, meaning the lesser the shipping time, the impact to the respondent is 0.64661 to the utility. Followed by a Shipping Cost with a coefficient of (+)0.60276, meaning if the shipping cost is reduced the impact on the respondent's utility is increased by 0.60276, next is Possibility to Plan deliveries with a coefficient of (+)0.48863, meaning the availability of possibility to plan delivery increases the utility of respondent by 0.48863. Last is Ability to track delivery with a coefficient of 0.46571, meaning if the respondents are given the ability to track their goods, their utility will increase the coefficient 0.46571, the is very different as compared with average sample were ability to track is the most important attribute with the highest coefficient, this data tells that different sociodemographic put more importance on different attributes.

The table 6.4 represents people who post goods once or twice a week or more , these people generally have a higher coefficients as compared with that of the individuals that post goods less than once or twice a week, meaning the impact to the utility is greater to these individual

when an attribute is increased or reduced, there for focus should be placed more on the particular group of individuals. Both groups put more importance on the attributes shipping and shipping cost respectively.

Comparing table 6.4 to the average (total sample) were ability to track delivery was the most important attribute here shipping time is the most important attribute and both tables have possibility to plan deliveries as the least important.

Table 6.5: Sub-sample Demand Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.49388**	.23389	2.11	.0347
Ability to Track (Yes)	.67639***	.22853	2.96	.0031
Shipping Time (Less)	.57760***	.20556	2.81	.0050
Possibility to Plan deliveries (Yes)	.44883**	.20647	2.17	.0297

***, **, * ==> Significance at 1%, 5%, 10% level. reject; Q4a_1=0

[e] Respect to other existing delivery services

*base level: "equal costs"; **base level: "No"; ***base level: " equal times "; ****base level: "No".

Table 6.5.1: Sub-sample Demand Model Statistics

Number of observations (individual)	96(32)
Skipped observations	18(3)
Estimation observations	78(26)
Log likelihood function	-46.14493

Table 6.6: Sub-sample Demand Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.78251***	.28955	2.70	.0069
Ability to Track (Yes)	.93869***	.29878	3.14	.0017
Shipping Time (Less)	.78368***	.27245	2.88	.0040
Possibility to Plan deliveries (Yes)	.69477**	.27467	2.53	.0114

***, **, * ==> Significance at 1%, 5%, 10% level. reject Q4a_1=1

[f] Respect to other existing delivery services

Table 6.6.1: Sub-sample Demand Model Statistics

Number of observations (individual)	84(23)
Skipped observations	12(4)
Estimation observations	72(24)
Log likelihood function	-39.45016

The above subsamples represent who have respondent had heard of crowd shipping; they were given the options Yes and No.

The first table represents the individual who said they had heard of crowd shipping and knew what it was, all the coefficients were significant, with the highest coefficient being 0.67639 representing ability to track delivery, followed by shipping time, shipping cost and then lastly possibility to plan delivery with a coefficient of 0.44883.

The table 6.5 and table 6.6 representing the individuals who haven't heard of crowd shipping have higher coefficient even as compared to the average sample (table 6.1) with the highest coefficient being 0.93869 representing the ability to track deliveries , followed by shipping time (0.78368), then shipping cost (0.78251) and finally ability to plan deliveries (0.69477).

This means people who have never heard of crowd shipping have higher impact on utility when and attribute increases or decreases, or when is available or unavailable especially ability to track.

Table 6.7: Sub-sample Demand Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.52487***	.17629	2.98	.0029
Ability to Track (Yes)	.51795***	.15954	3.25	.0012
Shipping Time (Less)	.57043***	.14652	3.89	.0001
Possibility to Plan deliveries (Yes)	.47239***	.14891	3.17	.0015

***, **, * ==> Significance at 1%, 5%, 10% level.

[g] Respect to other existing delivery services

Table 6.7.1: Sub-sample Demand Model Statistics

Number of observations (individual)	168
Skipped observations	25
Estimation observations	143
Log likelihood function	-86.37715

Table 6.8: Sub-sample Demand Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.25814	.24499	1.05	.2920
Ability to Track (Yes)	.41580*	.23786	1.75	.0805
Shipping Time (Less)	.52403**	.21252	2.47	.0137
Possibility to Plan deliveries (Yes)	.37590*	.21343	1.76	.0782

***, **, * ==> Significance at 1%, 5%, 10% level.

[h] Respect to other existing delivery services

Table 6.8.1: Sub-sample Demand Model Statistics

Number of observations (individual)	72
Skipped observations	9
Estimation observations	63
Log likelihood function	-38.00478

Table 6.9: Sub-sample Demand Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Shipping Cost (Less)	.76598***	.22352	3.43	.0006
Ability to Track (Yes)	.81068***	.21430	3.78	.0002
Shipping Time (Less)	.74394***	.19614	3.79	.0001
Possibility to Plan deliveries (Yes)	.59772***	.19551	3.06	.0022

***, **, * ==> Significance at 1%, 5%, 10% level.

Table 6.9.1: Sub-sample Demand Model Statistics

Number of observations (individual)	132
Skipped observations	20
Estimation observations	112
Log likelihood function	-61.58031

This subsample is grouped based on the age range of the respondents, meaning the tables show the groups and how each attributes impact on the utility, the age groups were 1) 15 to 25 2) 26 to 45 3) 46 to 65 4) 66 to 80 5) 81 and above.

Table 6.7 represents the age group 15 to 25; this age group is the youngest and they and the most important attribute is shipping time (+)0.57043, followed by shipping cost (+)0.52487, then Ability to track (0.51795), then finally possibility to plan deliveries.
Comparing it to the average sample (6.1), all the coefficients are less meaning, the impact that the attributes have on the age group from 15 to 25 when there is an increase or decrease is less as compared to average in table 6.1.

The second age group that is from 26 to 45 is also represented in table 6.8, here not all the attributes were significant, Shipping cost was not significant meaning in the age, a reduction in the attribute shipping cost does not affect the utility of the respondent. But the other attributes were significant with shipping time (0.524039 being the most important attribute affecting utility, followed by Ability to track (0.41580) then shipping time (0.37590). the coefficient not being very significant be attributed to the limited number of observations.

The final age group was above 45, it is represented by table 6.9, here all the coefficients are very significant, with the highest being Ability to track, followed by shipping cost then shipping , lastly ability to plan delivery, in this age group the coefficients are higher than the average meaning individuals in this age groups utility is highly impacted when the attributes increase or decrease.
From all the age groupings the one who a change in attributes impacts the most on their utility is the age grouping above 45 followed by 15 to 25 then 26 to 45.

6.2.2 Supply Results

This section describes the results of the supply side. Methodological and descriptive analogies with the question side will be left out in order to lead the reader to the main results.

The structure used in the models for estimating coefficients is still composed of 3 alternatives: Option A, Option B, and "No Choice".

The utilities are defined as follows:

utility $_{Option\ A}$ = β_1*Remuneration $_A$ + β_2 *location of lockers $_A$ + β_{3*} *Bank Crediting Modes* $_A$ + β_{4*} *Pick up arrangement* $_A$

utility $_{Option\ B}$ = β_1*Remuneration $_B$ + β_2 *location of lockers $_B$ + β_{3*} *Bank Crediting Modes* $_B$ + β_{4*} *Pick-up arrangement* $_B$

The following are the estimated model reports.

Table 6.10: Supply Variable Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.35822***	.09807	3.65	.0003
Location of lockers (inside the locker room)	.60332***	.11781	5.12	.0000
Bank Crediting modes (Single deliveries)	.06181	.12499	.49	.6209
Pick up arrangement (with reservation)	-.35948***	.11143	-3.23	.0013

***, **, * ==> Significance at 1%, 5%, 10% level.

[i] Respect to other existing delivery services

Table 6.10.1: Supply Model Statistics

Number of observations (individual)	252
Skipped observations	23
Estimation observations	229
Log likelihood function	-99.75446

The above tables show results for the overall sample taken; all the attributes are dummy variables; all the attributes were significant except bank crediting modes. This is understandable because during the administration of the questionnaire some individual wanted single deliveries because they did not know how often they were going to get goods to delivered so they wanted their money early and others wanted after 5 deliveries because they preferred the money being accumulated then sent to them in bulk.

From the significant coefficients, Location of lockers is the most important attribute with (+.60332) coefficient variable, meaning the location of the locker inside the metro station increase the utility of the crowd shipper since or she must not walk distance to go and deliver the package, followed by Pickup arrangement with a coefficient of (-0.35948), meaning when the individuals are told ahead of time that they will pick packages and deliver it reduces their utility or willingness to act as crowd shippers by 0.35948, the next attribute is remuneration with a coefficient of 0.35822, meaning the more individuals will be paid the more they will be will to act as crowd shipper or the utility of individuals increase by 0.35822 with they are paid more. Number of observations 252, but 229 of them was estimated because 23 of the observation was skipped because the software saw them as not fit for use.

Presented below are the results of the subsamples as compare to the total sample, these give a good explanation on how specific socio demographics are willing to act as crowd shippers.

Table 6.11: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.21741*	.11410	1.91	.0567
Location of lockers (inside the locker room)	.77745***	.15465	5.03	.0000
Bank Crediting modes (Single deliveries)	.23290	.16076	1.45	.1474
Pick up arrangement (with reservation)	-.29986**	.12484	-2.40	.0163

***, **, * ==> Significance at 1%, 5%, 10% level.

[j] Respect to other existing delivery services

Table 6.11.1: Sub-sample Supply Model Statistics

Number of observations (individual)	198
Skipped observations	23
Estimation observations	175
Log likelihood function	-72.68355

Respondents were asked the reason why they often commute or use the metro option were 1) study 2) work 3) free time 4) other.

The table 6.11 was estimated based on the number of individuals who often use the metro for work, All the tables were significant again except bank crediting modes, the attribute with the highest coefficient was (+0 .77745), followed by pickup up arrangement (-.29986) then remuneration 0.21741.

Comparing this to the average we notice location of locker is a very important attribute and even has a higher impact if the commuter is a worker, this because when a someone is going to work the person will have a higher utility or will be glad if they just have to deliver in a locker in the metro station rather than moving further distance to deliver. Remuneration and pickup arrangement had lesser impact as compared to the average sample. (table 6.10)

Table 6.12: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.89920***	.30357	2.96	.0031
Location of lockers (inside the locker room)	.44860	.29608	1.52	.1297
Bank Crediting modes (Single deliveries)	-.35577	.30871	-1.15	.2491
Pick up arrangement (with reservation)	-.83576**	.32936	-2.54	.0112

***, **, * ==> Significance at 1%, 5%, 10% level.

[k] Respect to other existing delivery services

Table 6.12.1: Sub-sample Supply Model Statistics

Number of observations (individual)	54
Skipped observations	0
Estimation observations	54
Log likelihood function	-19.23030

Table 6.13: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.06520	.24158	.27	.7872
Location of lockers (inside the locker room)	.80548***	.28398	2.84	.0046
Bank Crediting modes (Single deliveries)	.41253	.29347	1.41	.1598
Pick up arrangement (with reservation)	-.38785	.25454	-1.52	.1276

***, **, * ==> Significance at 1%, 5%, 10% level.

[l] Respect to other existing delivery services

Table 6.13.1: Sub-sample Supply Model Statistics

Number of observations (individual)	81
Skipped observations	8
Estimation observations	73
Log likelihood function	-29.76536

Respondents were asked if they had heard of crowd shipping. The first table represents the individuals who have heard of crowd shipping and the second table represents those who have not heard of crowd shipping. For the first table representing those who had heard of crowd shipping, they had 2 attributes being significant which are remuneration (+0.89920) and pickup arrangement (-0.83576). While those who had never heard of crowd shipping had only location

of lockers as significant; meaning in this case, when the locker is in metro station those who have never heard of crowd shipping have a positive utility of .80548.

Comparing this to the average table (table 6.10), we notice that still bank crediting modes are not significant in all. It means it does not impact the utility of the individual whether they have heard of crowd shipping before or not. Also, the coefficient in these tables are higher than the coefficient in the average table, showing that impact on utility is higher when they know or do not know about crowd shipping.

Table 6.14: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.44899***	.12158	3.69	.0002
Location of lockers (inside the locker room)	.56096***	.13960	4.02	.0001
Bank Crediting modes (Single deliveries)	-.06128	.14890	-.41	.6807
Pick up arrangement (with reservation)	-.43855***	.13807	-3.18	.0015

***, **, * ==> Significance at 1%, 5%, 10% level.

[m] Respect to other existing delivery services

Table 6.14.1: Sub-sample Supply Model Statistics

Number of observations (individual)	171
Skipped observations	15
Estimation observations	156
Log likelihood function	-66.99778

Table 6.15: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.59118***	.20673	2.86	.0042
Location of lockers (inside the locker room)	.52103**	.22330	2.33	.0196
Bank Crediting modes (Single deliveries)	-.25005	.23498	-1.06	.2873
Pick up arrangement (with reservation)	-.36503	.23521	-1.55	.1207

***, **, * ==> Significance at 1%, 5%, 10% level.

[n] Respect to other existing delivery services

Table 6.15.1: Sub-sample Supply Model Statistics

Number of observations (individual)	69
Skipped observations	4
Estimation observations	65
Log likelihood function	-29.00689

Table 6.16: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.22314	.13975	1.60	.1103
Location of lockers (inside the locker room)	.64828***	.18245	3.55	.0004
Bank Crediting modes (Single deliveries)	.23993	.19151	1.25	.2103
Pick up arrangement (with reservation)	-.38511**	.15494	-2.49	.0129

***, **, * ==> Significance at 1%, 5%, 10% level.

[o] Respect to other existing delivery services

Table 6.16.1: Sub-sample Supply Model Statistics

Number of observations (individual)	126
Skipped observations	10
Estimation observations	116
Log likelihood function	-49.41924

This subsample results above was generated after estimating the age group of the respondents, they had the age range 1) 15 to 25 2) 26 to 45 3) 46 to 65 4) 66 to 80 5) 81 and above.
The first table (table 6.14) represent the age group from 15 to 25, three of the attributes were significant, which were remuneration (0 .44899), location of lockers (0.56096) and pickup arrangement (-0.43855), comparing this to average only location of lockers had a lower coefficient, meaning generally the utility of the age group 15 to 25 is easily impacted when the attributes increases or decreases.

The second table (table 6.15) represents the second age group from 26 to 45. Remuneration (0.59118) and location of lockers (0.52103) were significant meaning in this group their utility is affected when the remuneration increases or decreases and whether the location if the locker is in the metro station or not.

The third table (table 6.16) shows the age group above 45, Remuneration (0.64828) and pickup arrangement (-0.38511) were the significant attributes, meaning these were the attributes that impacts the age group.
Comparing all the three tables to the average, apart from some of the attributes not being significant most the attributes have higher coefficient than the average, which tells us that the age group of an individual affects his or her willingness to act a crowd shipper.

Table 6.17: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.33456	.24210	1.38	.1670
Location of lockers (inside the locker room)	7.94762	387763.5	.00	1.0000
Bank Crediting modes (Single deliveries)	7.29479	387763.5	.00	1.0000
Pick up arrangement (with reservation)	-.39251	.24061	.00	.1028

***, **, * ==> Significance at 1%, 5%, 10% level.

[p] Respect to other existing delivery services

Table 6.17.1: Sub-sample Supply Model Statistics

Number of observations (individual)	57
Skipped observations	9
Estimation observations	48
Log likelihood function	-15.04477

Table 6.18: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.37767**	.14893	2.54	.0112
Location of lockers (inside the locker room)	.60139***	.17205	3.50	.0005
Bank Crediting modes (Single deliveries)	.05555	.17439	.32	.7501
Pick up arrangement (with reservation)	-.17231	.16924	-1.02	.3086

***, **, * ==> Significance at 1%, 5%, 10% level.

[q] Respect to other existing delivery services

Table 6.18.1: Sub-sample Supply Model Statistics

Number of observations (individual)	102
Skipped observations	7
Estimation observations	95
Log likelihood function	-47.23471

Table 6.19: Sub-sample Supply Results

Choice _Forced	Coefficient	Standard Error	Z value	Probability |z|>Z*
Remuneration (3£)	.33263**	.15826	2.10	.0356
Location of lockers (inside the locker room)	.51865**	.21949	2.36	.0181
Bank Crediting modes (Single deliveries)	.10727	.23120	.46	.6427
Pick up arrangement (with reservation)	-.57464***	.17589	-3.27	.0011

***, **, * ==> Significance at 1%, 5%, 10% level.

[r] Respect to other existing delivery services

Table 6.19.1: Sub-sample Supply Model Statistics

Number of observations (individual)	99
Skipped observations	11
Estimation observations	88
Log likelihood function	-33.47481

In this subsample, respondent's annual income was estimated to know If the annual income of an individual affects his or her willingness to act as a crowd shipper.

The first table (table 6.17) represents the individuals that earns less than 30,000 pounds, from the coefficient none of the attributes were significant, meaning the attributes does not significantly impact the utility of individuals who earn below 30,000 pounds.

The second table (table 6.18) represents the individuals who earn from 30,000 pounds to 40,000 pounds, in this category remuneration (0.37767) and location of lockers (0.60139) were significant , which implies that the utility of individuals who earn between 30,000 to 50,000 pounds utility is impacted when the remuneration increase or decrease and also when the locker is in metro station or outside the station.

The final table (table 6.19) is the income group above 50,000 pounds, three attribute are significant which are remuneration (0.33263), location of lockers(0.51865) and pickup arrangement (-.57464) , the shows that the income earns above 50,000 pounds are significantly impacted when the remuneration is increased, also their utility is positively impacted when the locker is in the metro station, finally they are impacted negatively when there is no pickup arrangement.

Comparing the tables to average sample (table 6.10) we notice that the significant ones are slightly higher than the average meaning when there is a change in the attributes, the utility of each income group especially the income group above 50,000 pounds is significantly impacted.

Chapter 7

7.0 Discussions

This chapter concentrates on the results of the analysis and indicates research culmination. The chapter shall also present implications for companies who look forward to exploiting the service, the limitations and finally, recommendations for further research.

7.1 Policy Implication

Companies are profit maximisers and do not just invest in any industry, the empirical findings above gives some insight on what companies should consider when making decision and developing policies. It throws light on whether people are willing to act as crowd-shippers and if there is a demand for the crowd-shipping service.

The data shows that there is a demand for crowd-shipping; however, consumer utility is dependent on shipping time, shipping cost, ability to track their deliveries and the possibility to plan when their deliveries will arrive. All these attributes affect the utility of customers and the most vital element that has a huge impact or significance, is the ability to track delivery. Consumers today want to know where their products are at any given period or point and not be left in the dark for a long time for their parcel to arrive. When this service is effectively provided, shipping time increases the utility of customers significantly, because they will receive their goods faster than the generic courier service. The shipping cost is the next important attribute; thus, when reduced as compared to the traditional shipping cost, impacts positively in the customers utility and when the utility is high the demand increases, hence increasing the profitability in the long run.

The possibility to plan deliveries is also essential and has impact on the utility of customers, hence providing this service will make more individuals purchase the crowd-shipping service and increase sales. When all attributes are implemented respectively, the utility of the customers will be high and customer loyalty rate will increase leading to higher profits.

The data also shows that individuals are willing to act as crowd-shippers when lockers that serve as drop-off or delivery points are located just at metro station/stops or less than 200 meters from the metro stations; this a very important attribute, especially to the individuals who

are already commuting to work, since they would not want to spend majority of their time on deliveries. Pickup arrangement, is also an attribute that if not present, may deter individuals from acting as crowd-shippers; Shippers would want to know before hand before picking up a parcel.

Also, they would want to know the exact time and delivery destination, since this gives them an idea or allows them to plan their day. Remuneration is the next significant attribute in increasing the chances of one being a crowd-shipper, the higher the earnings, the higher the utility and chance of one acting as a crowd-shipper. Bank crediting was a significant attribute; although individuals want to be paid after every single delivery, majority also did not mind getting paid after 5 deliveries. In this vein, the company accumulating and paying is the best policy, since it reduces the cost of processing and paying anytime one single delivery is done.

When all the above policies are implemented the probability that a crowd shipping service company will flourish in London is high.

7.2 Conclusion

The significance of this thesis was to ascertain the economic implications of the implementation of crowd-shipping, coupled with the theory of its impact on the environment. Also, the aim was to assess a possible solution to curb traffic congestion in urban areas.

Crowd-shipping is a relatively novel service that provides a sustainable way for goods to be delivered by individuals who already intend on moving from the point of origin to the destination. It allows commuters to act as courier servicepersons to reduce cost and traffic by eliminating or reducing exclusive courier activities.

The thesis considered London, the densest and most reputable economic region of Europe to back our economic and environmental theory. Moreover, according to Transport for London reports, (2019), London has one of the world's busiest and growing metro transport systems, thus, deeming it a suitable location for transport-based crowd-shipping.

It was imperative to outline two research questions to serve as blueprints for the research. Firstly, we sought to find out the conditions people of London would consider to increase the utility of the willingness to act as crowd shippers; this constituted the supply side of the study,

to know whether the people of London would buy into the idea to provide the service. Majority of our respondents were willing to supply the service with about 89 % of the total collected data falling in that category. Furthermore, from our outlined attributes, we realised the most integral factor that influenced the decision to act as a crowds-shipper was location of the lockers followed by pick-up arrangement, renumeration and bank crediting modes respectively.

Secondly, we wanted to find out the demand side of the service; that is, whether the people of London were interested in the crowd shipping service and would patronise it. More so, we realised that the service would be in demand, based on the results we gathered. From our data about 90% of the respondents were willing to patronise the service. Moreover, from our attributes, realised the most integral factor that influenced the decision to utilise the crowds-shipping service is ability to track delivery followed by shipping time, shipping cost and possibility to plan delivery respectively.

Ultimately, from our data, we realised that majority had the conviction that the service would be successful and beneficial in urban areas as compared to rural areas; we recorded a collective majority 65.5% of the respondents predicting a success rate ranging from 75% to 90%. That is to say, the congestion and traffic in the metropolitan regions can be curbed by exploiting the crowd-shipping service. Additionally, from or research, we propose two theories. Primarily, crowd-shipping is sustainable and proves beneficial for the environment since it reduces the number of vehicular traffic and in the long run, reduce carbon emissions (Bubner, Helbig and Jeske,2014. Lastly, stakeholders shall enjoy a reduction in the cost of transporting or delivering parcels; this stems from the cost parcel owners, retail and e-commerce companies pay to have packages delivered deliveries (Rouges and Montreuil, 2014; Lam and Li, 2015).

7.3 Limitations and Recommendations for Further Research

Although we are confident about our results, we encountered some limitations. Primarily, the thesis falters with a limited number of attributes, that may seem slightly inadequate for consumer preference. Again, we were hamstrung by the occurrence of the novel Covid-19 virus, which made data collection cumbersome. Thus, the sample size was relatively small.

For future studies, researches may employ a more systematic and quantitative study of the financial and environmental benefits and potentials of crowd-shipping. Again, a larger sample

should be used to gain more extensive results. Lastly, the operational side of the service should be considered for future studies.

References

1. Allen, J., Anderson, S., Browne, M. & Jones, P., (2000b). A framework for considering policies to encourage sustainable urban freight traffic and goods/service flows - Report 2: Current goods and service operations in urban areas. London: Transport Study Group, University of Westminster
2. Anderson, S., Allen, J. and Browne, M., 2005. Urban logistics—how can it meet policy makers' sustainability objectives? Journal of transport geography, 13(1), pp.71-81.
3. Andrejev, K., 2011. DHL Freight (Finland) 2020–Foresight study on Logistics in South-Eastern Finland.
4. Anon, 'Measures to Boost Sharing Economy in London' (2015), at <https://www.gov.uk/government/news/measures-to-boost-sharing-economy-in-london>.
5. Arslan, A.M., Agatz, N., Kroon, L. and Zuidwijk, R., 2019. Crowdsourced delivery—A dynamic pickup and delivery problem with ad hoc drivers. Transportation Science, 53(1), pp.222-235.
6. Arvidsson, N., 2013. Essays on operational freight transport efficiency and sustainability.
7. Arvidsson, N., Woxenius, J. and Lammgård, C., 2013. Review of road hauliers' measures for increasing transport efficiency and sustainability in urban freight distribution. Transport Reviews, 33(1), pp.107-127.
8. AtKearney, (2015). Europe's CEP Market: Steady growth begin to shift(https://www.atkearney.com/documents/10192/5544202/Europes+CEP+Market%E2%80%B9Steady+Gro wth+Begins+to+Shift.pdf/b63e4b9e-8979-4d54-a7bb-0ee9cf6008df, ultima consultazione 2 agosto 2017)
9. Baker, D., 2015. The Impact of Exempting the Pharmaceutical Industry from Patent Reviews. Center for Economic and Policy Research.
10. Behrend, M. and Meisel, F., 2018. The integration of item-sharing and crowd-shipping: Can collaborative consumption be pushed by delivering through the crowd? Transportation Research Part B: Methodological, 111, pp.227-243.
11. Belk, R., 2014. You are what you can access: Sharing and collaborative consumption online. Journal of business research, 67(8), pp.1595-1600.

12. Ben-Akiva, M. and Bolduc, D., (1996). Multinomial Probit with a Logit Kernel and a General Parametric Specification of the Covariance Structure. Working paper, Department of Civil Engineering
13. Blind, K., 2012. The impact of regulation on innovation: Compendium of evidence on the effectiveness of innovation policy intervention. Manchester Institute of Innovation Research, Manchester Business School, University of Manchester.
14. Botsman, R. and Rogers, R., 2010. Beyond zipcar: Collaborative consumption. Harvard Business Review, 88(10), p.30.
15. Boyer, K.K., Prud'homme, A.M. and Chung, W., 2009. The last mile challenge: evaluating the effects of customer density and delivery window patterns. Journal of business logistics, 30(1), pp.185-201.
16. Briffaz, M. and Darvey, C., 2016. Crowd-shipping in Geneva exploratory and descriptive study of Crowd-shipping.
17. Bubner, N., Bubner, N., Helbig, R. and Jeske, M., 2014. Logistics trend radar, Delivering insight today. Creating value tomorrow. DHL Customer Solutions & Innovation.
18. Burns, N.A., Grove, S.K. and Hegstad, L.N., 1987. Instructor's Manual to Accompany the Practice of Nursing Research. WB Saunders.
19. Carbone, V., Rouquet, A. and Roussat, C., 2015, June. Carried away by the crowd": what types of logistics characterise collaborative consumption. In 1st International Workshop on Sharing Econom, Utrecht, Netherlands.
20. Cardell, N.S., Dobson, R. and Dunbar, F.C., 1978. CONSUMER RESEARCH IMPLICATIONS OF RANDOM COEFFICIENT MODELS. Advances in Consumer Research, 5(1).
21. Chopra, S., Meindl, P. and Kalra, D.V., 2013. Supply chain management: strategy, planning, and operation (Vol. 232). Boston, MA: Pearson.
22. CHRISTOPHER, M., 1998. Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Services (London: Financial Times Pitman Publishing). 320.
23. Cohen, B. and Kietzmann, J., 2014. Ride on! Mobility business models for the sharing economy. Organization & Environment, 27(3), pp.279-296.
24. Cormack D F S (ed) (1991) The Research Process in Nursing 2nd edn Blackwell Scientific, Oxford

25. Cristea, A., Hummels, D., Puzzello, L. and Avetisyan, M., 2013. Trade and the greenhouse gas emissions from international freight transport. Journal of Environmental Economics and Management, 65(1), pp.153-173.
26. Davidov, G. and Langille, B. eds., 2011. The idea of labour law. Oxford University Press.
27. Denzin, N.K. and Lincoln, Y.S. eds., 2011. The Sage handbook of qualitative research. sage.
28. Denzin, N.K., and Y. S. Lincoln. 1994. Handbook of qualitative research. Sage publications, Inc.
29. DHL, (2008). Definition of CEP services. DHL trend research (https://www.ertrac.org/uploads/documentsearch/id36/ERTRAC_Alice_Urban_Freight.pdf)
30. Dieke, A-K., Bender, C., Campbell Jr., J., Cohen, R., Muller, C., Niederpmo,A., De Streel, A., Thiele, S. and Zanker, C., (2013). Main developments in the postal sector. Study for the European Commission, DG Internal Market. (2010-2013).
31. Doescher, T., (2016). Turning Independent Contractors into Employees Would Kill the Gig Economy. Foundation for Economic Education
32. Ducret, R. and Delaître, L., 2013. Parcel delivery and urban logistics-changes in urban courier, express and parcel services: the French case.
33. Ducret, R., 2014. Parcel deliveries and urban logistics: Changes and challenges in the courier express and parcel sector in Europe—The French case. Research in Transportation Business & Management, 11, pp.15-22.
34. Duffy, M.E., 1985. Designing nursing research: the qualitative-quantitative debate. Journal of advanced nursing, 10(3), pp.225-232.
35. Easterby-Smith, M., Thorpe, R. and Jackson, P.R., 2012. Management research. Sage.
36. Easterby-Smith, M., Thorpe, R. and Jackson, P.R., 2015. Management and business research. Sage.
37. Ehmke, J., 2012. Integration of information and optimization models for routing in city logistics (Vol. 177). Springer Science & Business Media.
38. Ernst & Young, (2015). The rise of the sharing economy: The Indian landscape. Ernst & Young LLP, Published in India.(http://sharehub.kr/wp-content/uploads/2015/11/e1a7c1d73dfae19dcfa0.pdf

39. Ertrac Urban mobility WG, (2014). Urban freight research road map. [http://www.ertrac.org/uploads/documentsearch/id36/ERTRAC_Alice_Urban_Freight.pdf, last consultation 2 August 2017]
40. European Commission, (2015). Clean transport, urban transport (https://ec.europa.eu/transport/themes/urban_en)
41. Freight Regulatory Measures on Transport Emissions—An Assessment. Sustainability 2018, 10, 2515
42. Gatta, V. and Marcucci, E., 2016. Stakeholder-specific data acquisition and urban freight policy evaluation: evidence, implications and new suggestions. Transport Reviews, 36(5), pp.585-609.
43. Gatta, V., Marcucci, E., Nigro, M. and Serafini, S., 2019. Sustainable urban freight transport adopting public transport-based crowd-shipping for B2C deliveries. European Transport Research Review, 11(1), p.13.
44. Gatta, V., Marcucci, E., Nigro, M., Patella, S.M. and Serafini, S., 2019. Public transport-based crowd-shipping for sustainable city logistics: Assessing economic and environmental impacts. Sustainability, 11(1), p.145.
45. Gevaers, R., Van de Voorde, E. and Vanelslander, T., 2009. Characteristics of innovations in last-mile logistics-using best practices, case studies and making the link with green and sustainable logistics. Association for European Transport and contributors.
46. Giuli, M. and Maselli, I., 2015. UBER: Innovation or déja vu? CEPS Commentary, 25 February 2015.
47. Green, P.E. and Srinivasan, V., 1990. Conjoint analysis in marketing: new developments with implications for research and practice. Journal of marketing, 54(4), pp.3-19.
48. Guba, E.G. and Lincoln, Y.S., 1994. Competing paradigms in qualitative research. Handbook of qualitative research, 2(163-194), p.105.
49. Hart, C. (1998). Doing a literature review: Releasing the social science research imagination. London, UK: Sage Publications
50. Hart, C., 1998. Hart, Chris, Doing a Literature Review: Releasing the Social Science Research Imagination. London: Sage, 1998.
51. Hassan, Z.A., Schattner, P. and Mazza, D., 2006. Doing a pilot study: why is it essential?. Malaysian family physician: the official journal of the Academy of Family Physicians of Malaysia, 1(2-3), p.70.

52. Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. Evidencebased nursing, ebnurs-2015.
53. Hensher, D.A. and Truong, T.P., 1983. Valuation of travel time savings from a revealed preference approach and a direct experimental approach (No. Monograph).
54. Hesse, M., 2008. The city as a terminal: The urban context of logistics and freight transport. Ashgate Publishing, Ltd.
55. Holguín-Veras, J. and Sánchez-Díaz, I., 2016. Freight demand management and the potential of receiver-led consolidation programs. Transportation Research Part A: Policy and Practice, 84, pp.109-130.
56. Hox, J.J. and Boeije, H.R. (2005). Data Collection, Primary versus Secondary. In K. KempfLeonard (ed.). Encyclopedia of Social Measurement. San Diego, CA:Academic Press
57. Imrie, R., Lees, L. and Raco, M. eds., 2009. Regenerating London: Governance, sustainability and community in a global city. Routledge.
58. Kessels, R., Jones, B. and Goos, P., 2011. Bayesian optimal designs for discrete choice experiments with partial profiles. Journal of Choice Modelling, 4(3), pp.52-74.
59. Khan, S.N., 2014. Qualitative research method: Grounded theory. International Journal of Business and Management, 9(11), pp.224-233.
60. Kin, B., Ambra, T., Verlinde, S. and Macharis, C., 2018. Tackling fragmented last mile deliveries to nanostores by utilizing spare transportation capacity—A simulation study. Sustainability, 10(3), p.653.
61. Kothari, C.R., 2004. Research methodology: Methods and techniques. New Age International.
62. KPMG., (2015). Global transport market trends and views. KPMG Transport Tracker. [https://assets.kpmg.com/content/dam/kpmg/pdf/2016/03/kpmg-transport-tracker.pdf, last consultation 15 November 2017]
63. Lam, T., and Li, C., (2015). Crowdsourced Delivery. Fung Business Intelligence Centre. https://www.fbicgroup.com/sites/default/files/Crowdsourced%20Delivery-SEP.2015.pdf
64. Lao, M., 2017. Workers in the 'Gig'Economy: The Case for Extending the Antitrust Labor Exemption to Them. SSRN Electronic Journal.

65. Le Pira, M., Marcucci, E. and Gatta, V., 2017. Role-playing games as a mean to validate agent-based models: An application to stakeholder-driven urban freight transport policymaking. Transportation Research Procedia, 27, pp.404-411.
66. Le Pira, M., Marcucci, E., Gatta, V., Ignaccolo, M., Inturri, G. and Pluchino, A., 2017. Towards a decision-support procedure to foster stakeholder involvement and acceptability of urban freight transport policies. European Transport Research Review, 9(4), p.54.
67. Leach, M., 1990. Philosophical choices. Nursing, 4(3), p.16.
68. Leveling, J., Edelbrock, M. and Otto, B., 2014, December. Big data analytics for supply chain management. In 2014 IEEE International Conference on Industrial Engineering and Engineering Management (pp. 918-922). IEEE.
69. Levy, Y. and Ellis, T.J., 2006. A systems approach to conduct an effective literature review in support of information systems research. Informing Science, 9.
70. Louviere, J.J., Hensher, D.A. and Swait, J.D., 2000. Stated choice methods: analysis and applications. Cambridge university press.
71. Lozzi, G., Gatta, V. and Marcucci, E., 2018. European urban freight transport policies and research funding: are priorities and H2020 calls aligned? Region: the journal of ERSA, 5(1), pp.53-71.
72. Macharis, C., De Witte, A. and Ampe, J., 2009. The multi-actor, multi-criteria analysis methodology (MAMCA) for the evaluation of transport projects: Theory and practice. Journal of Advanced transportation, 43(2), pp.183-202.
73. Magat, W. A., (1979). The Effects of Environmental Regulation on Innovation. Winter Spring, Vol. 43, No. 1
74. Mak, H.Y., 2018. Peer-to-peer crowd-shipping as an omnichannel retail strategy. Available at SSRN 3119687.
75. Malhotra, A. and Van Alstyne, M., 2014. The dark side of the sharing economy… and how to lighten it. Communications of the ACM, 57(11), pp.24-27.
76. Malhotra, N. K., Nunan, D., & Birks, D. F. (2017). Marketing research: an applied approach. New York: Pearson
77. Mangiaracina, R., Marchet, G., Perotti, S. and Tumino, A., 2015. A review of the environmental implications of B2C e-commerce: a logistics perspective. International Journal of Physical Distribution & Logistics Management.
78. Manski, C.F. and McFadden, D. eds., 1981. Structural analysis of discrete data with econometric applications (pp. 2-50). Cambridge, MA: MIT press.

79. Manski, C.F., 1977. The structure of random utility models. Theory and decision, 8(3), p.229.
80. Marazzi, D.G. and Perego, A., 2010. B2b integration with Logistics Service Providers: the case of the Home Appliances supply chain. In Proceedings of the 15th Annual Logistics Research Network Conference (pp. 444-452).
81. Marcucci, E. and Gatta, V., 2011. Regional airport choice: Consumer behaviour and policy implications. Journal of Transport Geography, 19(1), pp.70-84.
82. Marcucci, E. and Gatta, V., 2017. Investigating the potential for off-hour deliveries in the city of Rome: Retailers' perceptions and stated reactions. Transportation Research Part A: Policy and Practice, 102, pp.142-156.
83. Marcucci, E., Gatta, V. and Le Pira, M., 2018. Gamification design to foster stakeholder engagement and behavior change: An application to urban freight transport. Transportation Research Part A: Policy and Practice, 118, pp.119-132.
84. Marcucci, E., Gatta, V. and Scaccia, L., 2015. Urban freight, parking and pricing policies: An evaluation from a transport providers' perspective. Transportation Research Part A: Policy and Practice, 74, pp.239-249.
85. Marcucci, E., Le Pira, M., Gatta, V., Inturri, G., Ignaccolo, M. and Pluchino, A., 2017. Simulating participatory urban freight transport policy-making: Accounting for heterogeneous stakeholders' preferences and interaction effects. Transportation Research Part E: Logistics and Transportation Review, 103, pp.69-86.
86. Marcucci, E.; Gatta, V. Regional airport choice: Consumer behaviour and policy implications. J. Transp. Geogr.2011, 19, 70–84. [CrossRef]
87. Marcucci, E.; Gatta, V.; Le Pira, M.; Carrocci, C.S.; Pieralice, E. Connected shared mobility for passengers and freight: Investigating the potential of crowd-shipping in urban areas. In Proceedings of the 5th IEEE International Conference on Models and Technologies for Intelligent Transportation Systems, Naples, Italy, 26–28 June 2017; pp. 839–843.
88. McFadden, D. L. and Train, K. E., (1997). Mixed MNL models for discrete response. Working paper, Department of Economics, University of California at Berkeley.
89. Mehmann, J., Frehe, V. and Teuteberg, F., 2015. Crowd logistics− a literature review and maturity model. In Innovations and Strategies for Logistics and Supply Chains: Technologies, Business Models and Risk Management. Proceedings of the

Hamburg International Conference of Logistics (HICL), Vol. 20 (pp. 117-145). Berlin: epubli GmbH.

90. Mehmann, J., Frehe, V. and Teuteberg, F., 2015. Crowd logistics− a literature review and maturity model. In Innovations and Strategies for Logistics and Supply Chains: Technologies, Business Models and Risk Management. Proceedings of the Hamburg International Conference of Logistics (HICL), Vol. 20 (pp. 117-145). Berlin: epubli GmbH.
91. Merriam, S.B., 1988. Case study research in education: A qualitative approach. Jossey-Bass.
92. Miller, J., Nie, Y. and Stathopoulos, A., 2017. Crowdsourced urban package delivery: modeling traveler willingness to work as crowdshippers. Transportation Research Record, 2610(1), pp.67-75.
93. Miller, S.R., 2016. First principles for regulating the sharing economy. Harv. J. on Legis., 53, p.147.
94. Ministry of housing, communities and local government (2015) , measures to boost sharing economy in London https://www.wiredgov.net/wg/news.nsf/articles/Measures+to+boost+sharing+economy+in+London+10022015131500?open
95. Ministry of housing, communities and local government (2015) Promoting the sharing economy in London https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/402411/Promoting_the_sharing_economy_in_London.pdf
96. Montgomery, M.R., 2008. The urban transformation of the developing world. science, 319(5864), pp.761-764.
97. Morgan, Gareth, and Linda Smircich. 1980. "The case for qualitative research." Academy of management review 491-500.
98. Morganti, E., & Gonzalez-Feliu, J. (2015a). City logistics for perishable products. The case of the Parma's Food Hub. Case Studies on Transport Policy, 3(2), 120-128.
99. Morganti, E., & Gonzalez-Feliu, J. (2015b). The last food mile concept as a city logistics solution for perishable products. Enterprise Interoperability: Interoperability for Agility, Resilience and Plasticity of Collaborations (I-ESA 14 Proceedings), 202.

100. Muñuzuri, J., Larrañeta, J., Onieva, L. and Cortés, P., 2005. Solutions applicable by local administrations for urban logistics improvement. Cities, 22(1), pp.15-28.
101. Nunan, D., Birks, D.F. and Malhotra, N.K., 2020. Marketing Research. Pearson Higher Ed.
102. Oskarbski, J. and Kaszubowski, D., 2018. Applying a Mesoscopic Transport Model to Analyse the Effects of Urban Freight Regulatory Measures on Transport Emissions—An Assessment. Sustainability, 10(7), p.2515.
103. Owyang, J., 2016. Honeycomb 3.0: The collaborative economy market expansion. Retrieved on May, 4, p.2018.
104. Paloheimo, H., Lettenmeier, M. and Waris, H., 2016. Transport reduction by crowdsourced deliveries–a library case in Finland. Journal of Cleaner Production, 132, pp.240-251.
105. Peiling, Z. and Tingting, L., 2018. Understanding consumer preferences for logistics services within online retailing of fresh products: A research conducted on Swedish consumers.
106. Perego, E., 2008. What would we read best. Hypotheses and suggestions for the location of line breaks in film subtitles. The Sign Language Translator and Interpreter, 2(1), pp.35-63.
107. Piecyk, M., Browne, M., Whiteing, A. and McKinnon, A. eds., 2015. Green logistics: Improving the environmental sustainability of logistics. Kogan Page Publishers.
108. Porter, M.E. and Van der Linde, C., 1995. Toward a new conception of the environment-competitiveness relationship. Journal of economic perspectives, 9(4), pp.97-118.
109. Punel, A., Ermagun, A. and Stathopoulos, A., 2018. Studying determinants of crowd-shipping use. Travel Behaviour and Society, 12, pp.30-40.
110. Quak, H.J. and de Koster, M.R.B., 2009. Delivering goods in urban areas: how to deal with urban policy restrictions and the environment. Transportation science, 43(2), pp.211-227.
111. Rai, H. Buldeo., Verlinde, S., Merckx, J. and Macharis, C., 2017. Crowd logistics: an opportunity for more sustainable urban freight transport? European Transport Research Review, 9(3), p.39.
112. Ranchordás, S., 2015. Does sharing mean caring: Regulating innovation in the sharing economy. Minn. JL Sci. & Tech., 16, p.413.

113. Ranieri, L., Digiesi, S., Silvestri, B. and Roccotelli, M., 2018. A review of last mile logistics innovations in an externalities cost reduction vision. Sustainability, 10(3), p.782.
114. Robson, C., 2007. How to do a research project: A guide for university students.
1. Rome: Retailers'
115. Rose, J.M. and Bliemer, M.C., 2004. The design of stated choice experiments: The state of practice and future challenges.
116. Russo, F. and Comi, A., 2010. A classification of city logistics measures and connected impacts. Procedia-Social and Behavioral Sciences, 2(3), pp.6355-6365.
117. Rześny-Cieplińska, J. and Szmelter-Jarosz, A., 2019. Assessment of the Crowd Logistics Solutions—The Stakeholders' Analysis Approach. Sustainability, 11(19), p.5361.
118. Sancha, C., Gimenez, C. and Sierra, V., 2016. Achieving a socially responsible supply chain through assessment and collaboration. Journal of Cleaner Production, 112, pp.1934-1947.
119. Saracchi, S., 2012. Model of choice for the distribution of residences for urban mobility planning.
120. Saunders, M., Lewis, P., & Thornhill, A. (2009). Research Methods for Business Students (5th ed.). Halow: Pearson Education Limited.
121. Saunders, M., Lewis, P., & Thornhill, A. (2012). Research Methods for Business Students (6th ed.). Halow: Pearson Education Limited.
122. Saunders, M., Lewis, P., & Thornhill, A. (2015). Research Methods for Business Students (7th ed.). Halow: Pearson Education Limited.
123. Savelsbergh, M. and Van Woensel, T., 2016. 50th anniversary invited article—city logistics: Challenges and opportunities. Transportation Science, 50(2), pp.579-590.
124. Schulte, J. and Ny, H., 2018. Electric road systems: Strategic steppingstone on the way towards sustainable freight transport? Sustainability, 10(4), p.1148.
125. Silva, A.B. and Ribeiro, A., 2009, October. An integrated planning for cities to promote sustainable mobility. In Proceedings of European Transport Conference (p. 62).
126. Simoni, M.D., Marcucci, E., Gatta, V. and Claudel, C.G., 2019. Potential last-mile impacts of crowd-shipping services: a simulation-based evaluation. Transportation, pp.1-22.

127. Slabinac, M., 2015. Innovative solutions for a “Last-Mile” delivery–a European experience. Business Logistics in Modern Management.
128. Smorto, G., 2015. Towards the legal framework of the sharing economy. Market competition rules , 17 (2), pp.245-278.
129. Stathopoulos, A., Valeri, E., Marcucci, E., Gatta, V., Nuzzolo, A. and Comi, A., 2011. Urban freight policy innovation for Rome’s LTZ: a stakeholder perspective. City distribution and urban freight transport: multiple perspectives, pp.75-100.
130. Stewart, L.A., 2010. The impact of regulation on innovation in the United States: A cross-industry literature review. Information technology & innovation foundation, 6.
131. Stewart, O.T., Vernez Moudon, A., Saelens, B.E., Lee, C., Kang, B. and Doescher, M.P., 2016. Comparing associations between the built environment and walking in rural small towns and a large metropolitan area. Environment and Behavior, 48(1), pp.13-36.
132. Stewart, R.B., 1981. Regulation, innovation, and administrative law: A conceptual framework. Calif. L. Rev., 69, p.1256.
133. Stindt, D., Sahamie, R., Nuss, C. and Tuma, A., 2016. How transdisciplinarity can help to improve operations research on sustainable supply chains—a transdisciplinary modeling framework. Journal of Business Logistics, 37(2), pp.113-131.
134. Sundararajan, A., 2014. Peer-to-peer businesses and the sharing (collaborative) economy: Overview, economic effects and regulatory issues. Written testimony for the hearing titled The Power of Connection: Peer to Peer Businesses.
135. Szmelter-Jarosz, A. and Rześny-Cieplińska, J., 2019. Priorities of Urban Transport System Stakeholders According to Crowd Logistics Solutions in City Areas. A Sustainability Perspective. Sustainability, 12(1), pp.1-19.
136. Taniguchi, E., Thompson, R.G. and Yamada, T., 2012. Emerging techniques for enhancing the practical application of city logistics models. Procedia-Social and Behavioral Sciences, 39, pp.3-18.
137. Teoh, T., Kunze, O., Teo, C.C. and Wong, Y.D., 2018. Decarbonisation of urban freight transport using electric vehicles and opportunity charging. Sustainability, 10(9), p.3258.
138. The explosion in the use of the term occurred as a result of the Article Workers on Tap appeared in the Economist, January 3, 2015

139. Tugba Sabanoglu, 2020 E-commerce in the United Kingdom (UK) - Statistics & Facts https://www.statista.com/topics/2333/e-commerce-in-the-united-kingdom/
140. Tversky, A., 1972. Elimination by aspects: A theory of choice. Psychological review, 79(4), p.281.
141. United Nations 2019, World Urbanization Prospects report, Department of Economic and Social Affairs
142. United Nations, Department of Economic and Social Affairs, Population Division, 2019. World Urbanization Prospects: The 2018 Revision (ST/ESA/SER. A/420).
143. Varian, H., 1993. R. (1984), Microeconomic Analysis.
144. Wang, Y., Zhang, D., Liu, Q., Shen, F. and Lee, L.H., 2016. Towards enhancing the last-mile delivery: An effective crowd-tasking model with scalable solutions. Transportation Research Part E: Logistics and Transportation Review, 93, pp.279-293.
145. Warren, E., 2016. Strengthening the basic bargain for workers in the modern economy. New American Foundation Annual Conferece, 19.
146. Webster, J. and Watson, R.T., 2002. Analyzing the past to prepare for the future: Writing a literature review. MIS quarterly, pp.xiii-xxiii.
147. Wehner, J., 2018. Energy efficiency in logistics: an interactive approach to capacity utilisation. Sustainability, 10(6), p.1727.
148. Wesbter, R.A., 1992. The research process in nursing: DFS Cormack (ed) Blackwell Scientific Publications, Oxford, 1991, 2nd edn, 370 pages. Price£ 14.95.
149. World Population Review 2020 https://worldpopulationreview.com/world-cities/london-population/
150. Wosskow, D., 2014. Unlocking the Sharing Economy. An Independent Review; Department for Business. Innovation & Skills. UK Government

Appendices

Appendix A: QUESTIONNAIRE A1

[Supply side]

Please fill the answer into the grey cell

PRE-INTERVIEW QUESTIONS

1)The following questionnaire is only for those who frequently use metro network. Please confirm that you belong to this category?

1: Yes

2: No

2) what days do you often use the metro?

1 Weekdays

2 Weekend

3 weekdays and Weekend

4 Other

3a) Reason for movement or taking of trip

1 study

2 work

3 free time

4 Other

3b) What time of day do you frequently travel?

1 Morning before 12 pm

2 Afternoon before 5 pm

3 Evening before 10pm

4 Dawn before 6am

5 Morning and evening

6 Morning and afternoon

7 Morning, afternoon and evening

3c): Travel time (duration) : _____ (*Indicate the average time it takes to get to destination in minutes)*

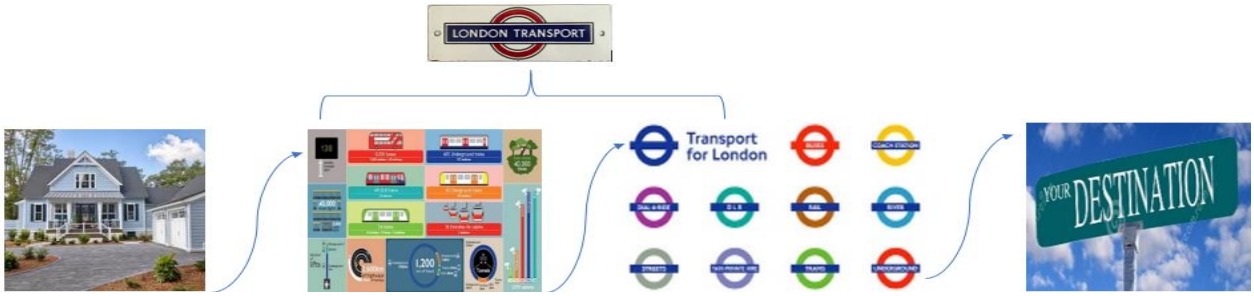
4: How do you pay for your metro fees?

1 I purchase single tickets per ride

2 I purchase daily tickets

3 I purchase monthly subscription

4 I purchase annual/yearly subscription



5a) How do you usually get to the metro station from your point of origin?

1 Walking

2 Bicycle

3 Motorcycle/moped/scooter

4 Private car

5 Public transport

6 Taxi /Uber

7 Car Pooling

8 Other

5b) If you transit what mode of transport do you use to get to your destination?

1 Walking

2 Bicycle

3 Motorcycle/moped/scooter

4 Private car

5 Public transport

6 Taxi /Uber

7 Car Pooling

8 Other

6a) Do you know about crowd-shipping

1 yes

2 No

6b) Have you ever patronized the service of a crowd-shipping company?

1 Yes

2 No

6c) If yes, indicate the one you have patronized?

1 Nimber (Easy bring)

2 Peggy Bee

3 Living Packets

4 Entruster

5 My box man

6 Other

SERVICE DESCRIPTION

Crowd-shipping is an alternative for courier delivery of goods, where travellers who will take trip routes often are used as transporters (crowd-shippers) to deliver the goods.

In this context we want to know if you will be willing to act as a **crowd-shipper**

7) If this service existed, would you try it?

1 Yes (please continue the questionnaire)

2 No (thanks for filling the questionnaire)

After reading the service description you will be offered some crowd shipping delivery alternatives. You'll be presented with some scenarios with multiple choice options that differ based on specific characteristics. For each scenario, we ask you to indicate your preferred option.

CHOICE TASK QUESTIONS

BLOCK 1

SCENARIO 1	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£1	£3
Pick up arrangement (how do you want to be informed before pickup)	without reservation	with reservation
bank crediting modes (how you want to be paid)	single delivery	5 deliveries

8a) ☐ 1 Option A
2 Option B
3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

SCENARIO 2	**Option A**	**option B**
Location of lockers	inside the metro stations/ stops	outside the metro stations/station
Remuneration (amount you will be paid)	£3	£1
Pick up arrangement (how do you want to be informed before pickup)	without reservation	with reservation

bank crediting modes (how you want to be paid)	5 deliveries	single delivery

9a) ☐ 1 Option A
2 Option B
3 None of the above

9b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

SCENARIO 3	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£3	£1
Pick up arrangement (how do you want to be informed before pickup	without reservation	with reservation
bank crediting modes (how you want to be paid)	single delivery	5 deliveries

10a) ☐ 1 Option A
2 Option B
3 None of the above

10b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

BLOCK 2

SCENARIO 1	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£3	£1
Pick up arrangement (how do you want to be informed before pickup)	With reservation	without reservation
bank crediting modes (how you want to be paid)	single delivery	5 deliveries

8a) ☐ 1 Option A
2 Option B
3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

SCENARIO 2	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£1	£3
Pick up arrangement (how do you want to be informed before pickup)	without reservation	with reservation
bank crediting modes (how you want to be paid)	single delivery	5 deliveries

9a) ☐ 1 Option A

2 Option B

3 None of the above

9b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 3	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£1	£3
Pick up arrangement (how do you want to be informed before pickup)	without reservation	with reservation
bank crediting modes (how you want to be paid)	5 deliveries	single delivery

10a) ☐ 1 Option A

2 Option B

3 None of the above

10b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

BLOCK 3

SCENARIO 1	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£1	£3
Pick up arrangement (how do you want to be informed before pickup)	Without reservation	with reservation
bank crediting modes (how you want to be paid)	single delivery	5 deliveries

8a) ☐ 1 Option A

2 Option B

3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 2	**Option A**	**option B**
Location of lockers	inside the metro stations/ stops	outside the metro stations/station
Remuneration (amount you will be paid)	£1	£3
Pick up arrangement (how do you want to be informed before pickup)	without reservation	with reservation
bank crediting modes (how you want to be paid)	5 deliveries	single delivery

9a) ☐ 1 Option A

2 Option B

3 None of the above

9b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 3	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£1	£3
Pick up arrangement (how do you want to be informed before pickup)	without reservation	with reservation
bank crediting modes (how you want to be paid)	5 deliveries	single delivery

10a) ☐ 1 Option A

2 Option B

3 None of the above

10b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

BLOCK 4

SCENARIO 1	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£3	£1
Pick up arrangement (how do you want to be informed before pickup)	Without reservation	with reservation
bank crediting modes (how you want to be paid)	5 deliveries	single delivery

8a) ☐ 1 Option A
2 Option B
3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

SCENARIO 2	**Option A**	**option B**
Location of lockers	inside the metro stations/ stops	outside the metro stations/station
Remuneration (amount you will be paid)	£1	£3
Pick up arrangement (how do you want to be informed before pickup)	without reservation	with reservation
bank crediting modes (how you want to be paid)	5 deliveries	single delivery

9a) ☐ 1 Option A

2 Option B

3 None of the above

9b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 3	**Option A**	**option B**
Location of lockers	outside the metro stations/ stops	inside the metro stations/station
Remuneration (amount you will be paid)	£3	£1
Pick up arrangement (how do you want to be informed before pickup)	with reservation	without reservation
bank crediting modes (how you want to be paid)	single delivery	5 deliveries

10a) ☐ 1 Option A

2 Option B

3 None of the above

10b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SUSTAINABILITY QUESTIONS

11) Kindly indicate how you are likely to act (choose only one answer in each line)

a		I am very keen on hearing about environmental issue
b		I happen to collect waste materials(trash) in parks/beaches/roads even it is left by others
c		I sign petitions for environmental protection
d		I prefer to use less polluting means of transport than cars
e		I direct my choices towards sustainable eco-friendly products and services
f		I happen to use sharing services (car sharing, Airbnb, Uber etc...)

Legend/Key

Strongly disagree = 1

Disagree = 2

Neutral = 3

Agree = 4

Strongly agree = 5

POST-INTERVIEW QUESTIONS

12) In the event that you are delivering a package how much further are you willing to travel?

1 0 meters (Right at the metro stations/stops)

2 1-300 meters

3 301-600 meters

4 601-1200 meters

5 more than 1200 meters

13) How confident are you that this service can be successful?

1 10%

2 25%

3 50%

4 75%

5 90%

14) How confident are you that this service can be extended beyond the urban environment

1 10%

2 25%

3 50%

4 75%

5 90%

Appendix B: QUESTIONNAIRE A1

[Demand side]

Please fill the answer into the grey cell

Høgskolen i Molde
Vitenskapelig høgskole i logistikk

1)The following questionnaire is only for those who frequently use metro network. Please confirm that you belong to this category?

1: Yes

2: No

2) How often do you buy small/medium-sized goods over the internet?

1 Rarely or never

2 Sometimes in a year

3 Once in a month

4 Two or three times a month

5 Once or twice a week

6 At least three times a week

3) How often do you post or sent small/medium goods through courier service?

1 Rarely or never

2 Few times a year

3 Once a month

4 Two or three times a month

5 Once or twice a week

6 At least three times a week

4a) Have you heard of crowd-shipping?

1 Yes

2 No

4b) If yes, have you ever patronized a crowd-shipping service?

1 Yes

2 No

4c) If yes, was it for sending or you receiving a product?

1 sending

2 Receiving

4d) If yes please choose the company?

1 Nimber (Easy bring)

2 Peggy Bee

3 Living Packets

4 Entruster

5 My box man

6 Other

SERVICE DESCRIPTION

Crowd-shipping is an alternative for courier delivery of goods, where travellers who will take trip routes often are used as transporters (crowd-shippers) to deliver the goods.

In this context we want to know if you will be willing to act as a **crowd-shipper**

5) **If this service existed, would you try it?**

1 Yes (please continue the questionnaire)

2 No (thanks for filling the questionnaire)

After reading the service description you will be offered some crowd shipping delivery alternatives. You'll be presented with some scenarios with multiple choice options that differ based on specific characteristics. For each scenario, we ask you to indicate your preferred option.

CHOICE TASK QUESTIONS

BLOCK 1

SCENARIO 1	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Equal	Less
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	Yes	No
Possibility to plan delivery date	Yes	No

6a) ☐ 1 Option A

2 Option B

3 None of the above

6b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 2	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Less	Equal
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	No	Yes
Possibility to plan delivery date	Yes	No

7a) ☐ 1 Option A

2 Option B

3 None of the above

7b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 3	**Option A**	**Option B**
shipping cost (as compared to traditional shipping service)	Equal	Less
shipping time (as compared to traditional shipping service)	Less	Equal
Ability to track delivery	Yes	No
Possibility to plan delivery date	Yes	No

8a) ☐ 1 Option A
2 Option B
3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

BLOCK 2

SCENARIO 1	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Less	Equal
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	No	Yes
Possibility to plan delivery date	Yes	No

6a) ☐ 1 Option A
2 Option B
3 None of the above

6b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A

2 Option B

SCENARIO 2	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Less	Equal
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	Yes	No
Possibility to plan delivery date	No	Yes

7a) ☐ 1 Option A

2 Option B

3 None of the above

7b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 3	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Equal	Less
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	No	No
Possibility to plan delivery date	Yes	Yes

8a) ☐ 1 Option A

2 Option B

3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

BLOCK 3

SCENARIO 1	**Option A**	**Option B**
shipping cost (as compared to traditional shipping service)	Less	Equal
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	No	Yes
Possibility to plan delivery date	Yes	No

6a) ☐ 1 Option A
2 Option B
3 None of the above

6b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

SCENARIO 2	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Less	Equal
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	No	Yes
Possibility to plan delivery date	No	Yes

7a) ☐ 1 Option A
2 Option B
3 None of the above

7b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

SCENARIO 3	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Equal	Less
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	Yes	No
Possibility to plan delivery date	Yes	No

8a) ☐ 1 Option A
2 Option B
3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A
2 Option B

BLOCK 4

SCENARIO 1	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Less	Equal
shipping time (as compared to traditional shipping service)	Equal	Less
Ability to track delivery	Yes	No
Possibility to plan delivery date	No	Yes

6a) ☐ 1 Option A
2 Option B
3 None of the above

6b) ☐ **if you chose none of the above, what option do you prefer?**
1 Option A

2 Option B

SCENARIO 2	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Less	Equal
shipping time (as compared to traditional shipping service)	Less	Equal
Ability to track delivery	No	Yes
Possibility to plan delivery date	No	Yes

7a) ☐ 1 Option A

2 Option B

3 None of the above

7b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SCENARIO 3	**Option A**	**option B**
shipping cost (as compared to traditional shipping service)	Equal	Less
shipping time (as compared to traditional shipping service)	Less	Equal
Ability to track delivery	No	Yes
Possibility to plan delivery date	Yes	No

8a) ☐ 1 Option A

2 Option B

3 None of the above

8b) ☐ **if you chose none of the above, what option do you prefer?**

1 Option A

2 Option B

SUSTAINABILITY QUESTIONS

9) Kindly indicate how you are likely to act (choose only one answer in each line)

a		I am very keen on hearing about environmental issue
b		I happen to collect waste materials(trash) in parks/beaches/roads even it is left by others
c		I sign petitions for environmental protection
d		I prefer to use less polluting means of transport than cars
e		I direct my choices towards sustainable eco-friendly products and services
f		I happen to use sharing services (car sharing, Airbnb, Uber etc...)

Legend/Key

Strongly disagree = 1

Disagree = 2

Neutral = 3

Agree = 4

Strongly agree = 5

POST-INTERVIEW QUESTIONS

10) if you accept this mode of transport what will be the most preferred time that you will like your item to be delivered?

1 Morning before 12 pm

2 Afternoon before 5pm

3 Evening before 10pm

4 Night before 6am

5 Morning and evening

6 Morning and afternoon

7 Morning afternoon and evening

8 unspecified

11) In the event that your parcel is being delivered what is the maximum length you are willing to travel for your parcel?

1 0 meters (Home/ Work place)
2 0-300 meters
3 300-600 meters
4 600-1200 meters
5 more than 1200 meters

12) How confident are you that this service can be successful?

1 10%
2 25%
3 50%
4 75%
5 90%

13) How confident are you that this service can be extended beyond the urban environment

1 10%
2 25%
3 50%
4 75%
5 90%

14)how long will you prefer that your parcel will take before it is delivered?

1 Less than 3 hours
2 From 3 to 6 hours
3 One day
4 Up to 3 days
5 Over 3 days

Appendix C: Demand Results

DEMAND RESULTS

```
sample; all$
-------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -126.86596
Estimation based on N = 216, K = 4
Inf.Cr.AIC = 261.7 AIC/N = 1.212
---------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.= 252, skipped 36 obs
--------+----------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+----------------------------------------------------------------------
--
 SC| .60095*** .14675 4.10 .0000 .31333 .88857
 ATD| .63745*** .13887 4.59 .0000 .36527 .90962
 ST| .62908*** .12775 4.92 .0000 .37869 .87947
 PPDD| .52138*** .12791 4.08 .0000 .27068 .77207
--------+----------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
```

Partitioning the sample

```
|-> create; Q2_1=0$
|-> create; if (Q2<5) Q2_1=1$

|-> create; Q3_1=0$
|-> create; if (Q3<3) Q3_1=1$

|-> create; Q4a_1=0$
|-> create; if (Q4a=1) Q4a_1=1$

|-> create; Q16_1=0$
|-> create; if (Q16=1) Q16_1=1$
|-> create; Q16_2=0$
|-> create; if (Q16=2) Q16_2=1$
|-> create; Q16_3=0$
|-> create; if (Q16>2) Q16_3=1$
```

```
|-> create; Q17_1=0$
|-> create; if (Q17=1) Q17_1=1$
|-> create; Q17_2=0$
|-> create; if (Q17=2) Q17_2=1$
|-> create; Q17_3=0$
|-> create; if (Q17>2) Q17_3=1$


|-> sample; all$
|-> reject; Q2_1=0$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 18 bad observations among 123 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .5885048D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -58.85048
Estimation based on N = 105, K = 4
Inf.Cr.AIC = 125.7 AIC/N = 1.197
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 123, skipped 18 obs
--------+---------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+---------------------------------------------------------------------
--
 SC| .63812*** .22016 2.90 .0037 .20662 1.06962
 ATD| .85517*** .22086 3.87 .0001 .42230 1.28804
 ST| .64704*** .19844 3.26 .0011 .25809 1.03598
 PPDD| .58094*** .19841 2.93 .0034 .19207 .96981
--------+---------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:29 PM
------------------------------------------------------------------------------
--
```

```
|-> sample; all$
|-> reject; Q2_1=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 18 bad observations among 129 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .6524527D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -65.24527
Estimation based on N = 111, K = 4
Inf.Cr.AIC = 138.5 AIC/N = 1.248
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 129, skipped 18 obs
--------+---------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+---------------------------------------------------------------------
--
 SC| .60276*** .20347 2.96 .0031 .20397 1.00155
 ATD| .46571** .18120 2.57 .0102 .11057 .82085
 ST| .64661*** .17213 3.76 .0002 .30925 .98398
 PPDD| .48863*** .17106 2.86 .0043 .15335 .82391
--------+---------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:29 PM
------------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q3_1=0$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
```

```
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 18 bad observations among 156 individuals. |
|You can use ;CheckData to get a list of these points. |
+----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .7990179D+02

---------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -79.90179
Estimation based on N = 138, K = 4
Inf.Cr.AIC = 167.8 AIC/N = 1.216
---------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.= 156, skipped 18 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 SC| .66671*** .18983 3.51 .0004 .29466 1.03876
 ATD| .61876*** .17609 3.51 .0004 .27364 .96389
 ST| .67022*** .16493 4.06 .0000 .34696 .99348
 PPDD| .55964*** .16407 3.41 .0006 .23808 .88120
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:29 PM
---------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q3_1=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 18 bad observations among 96 individuals. |
|You can use ;CheckData to get a list of these points. |
+----------------------------------------------------+
```

```
Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .4614493D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -46.14493
Estimation based on N = 78, K = 4
Inf.Cr.AIC = 100.3 AIC/N = 1.286
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 96, skipped 18 obs
--------+---------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+---------------------------------------------------------------------
--
 SC| .49388** .23389 2.11 .0347 .03546 .95231
 ATD| .67639*** .22853 2.96 .0031 .22848 1.12431
 ST| .57760*** .20556 2.81 .0050 .17471 .98050
 PPDD| .44883** .20647 2.17 .0297 .04416 .85350
--------+---------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:30 PM
------------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q4a_1=0$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 11 bad observations among 84 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 7 iterations. Status=0, F= .3945016D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -39.45016
```

```
Estimation based on N = 73, K = 4
Inf.Cr.AIC = 86.9 AIC/N = 1.190
-------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
-------------------------------------
Response data are given as ind. choices
Number of obs.= 84, skipped 11 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 SC| .78251*** .28955 2.70 .0069 .21501 1.35000
 ATD| .93869*** .29878 3.14 .0017 .35309 1.52429
 ST| .78368*** .27245 2.88 .0040 .24969 1.31767
 PPDD| .69477** .27467 2.53 .0114 .15642 1.23312
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:30 PM
-----------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q4a_1=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+---------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 25 bad observations among 168 individuals. |
|You can use ;CheckData to get a list of these points. |
+---------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .8637715D+02

-----------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -86.37715
Estimation based on N = 143, K = 4
Inf.Cr.AIC = 180.8 AIC/N = 1.264
-------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
```

```
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.= 168, skipped 25 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 SC| .52487*** .17629 2.98 .0029 .17934 .87040
 ATD| .51795*** .15954 3.25 .0012 .20527 .83064
 ST| .57043*** .14652 3.89 .0001 .28326 .85760
 PPDD| .47239*** .14891 3.17 .0015 .18054 .76425
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:30 PM
------------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q16_2=1$
|-> reject; Q16_3=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+---------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 9 bad observations among 72 individuals. |
|You can use ;CheckData to get a list of these points. |
+---------------------------------------------------+

Iterative procedure has converged
Normal exit: 5 iterations. Status=0, F= .3800478D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -38.00478
Estimation based on N = 63, K = 4
Inf.Cr.AIC = 84.0 AIC/N = 1.333
---------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.= 72, skipped 9 obs
--------+------------------------------------------------------------------
--
```

```
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 SC| .25814 .24499 1.05 .2920 -.22204 .73831
 ATD| .41580* .23786 1.75 .0805 -.05040 .88201
 ST| .52403** .21252 2.47 .0137 .10750 .94057
 PPDD| .37590* .21343 1.76 .0782 -.04242 .79422
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:30 PM
-----------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q16_1=1$
|-> reject; Q16_3=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+---------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 20 bad observations among 132 individuals. |
|You can use ;CheckData to get a list of these points. |
+---------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .6158031D+02

-----------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -61.58031
Estimation based on N = 112, K = 4
Inf.Cr.AIC = 131.2 AIC/N = 1.171
-------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
-------------------------------------
Response data are given as ind. choices
Number of obs.= 132, skipped 20 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 SC| .76598*** .22352 3.43 .0006 .32789 1.20408
 ATD| .81068*** .21430 3.78 .0002 .39066 1.23070
 ST| .74394*** .19614 3.79 .0001 .35950 1.12838
```

```
 PPDD| .59772*** .19551 3.06 .0022 .21451 .98092
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:31 PM
-----------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q16_1=1$
|-> reject; Q16_2=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=sc*sc+atd*atd+st*st+ppdd*ppdd/
 U(B)=sc*sc+atd*atd+st*st+ppdd*ppdd$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 7 bad observations among 48 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .2446806D+02

-----------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -24.46806
Estimation based on N = 41, K = 4
Inf.Cr.AIC = 56.9 AIC/N = 1.389
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 48, skipped 7 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 SC| .79617** .35227 2.26 .0238 .10573 1.48661
 ATD| .58056* .30578 1.90 .0576 -.01876 1.17989
 ST| .52578* .29509 1.78 .0748 -.05258 1.10414
 PPDD| .61595** .30502 2.02 .0435 .01811 1.21378
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 07:33:31 PM
-----------------------------------------------------------------------------
--
```

Appendix D: Supply Results

SUPPLY RESULTS

```
sample; all$
-------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -99.75446
Estimation based on N = 229, K = 4
Inf.Cr.AIC = 207.5 AIC/N = .906
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 252, skipped 23 obs
--------+----------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+----------------------------------------------------------------------
--
 REM| .35822*** .09807 3.65 .0003 .16600 .55043
 LOC| .60332*** .11781 5.12 .0000 .37242 .83421
 BANKCD| .06181 .12499 .49 .6209 -.18316 .30678
 PICARR| -.35948*** .11143 -3.23 .0013 -.57788 -.14108
--------+----------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
```

Partitioning the sample

```
|-> create; Q3a2=0$
|-> create; if (Q3A=2) Q3a2=1$

|-> create; Q6a1=0$
|-> create; if (Q6A=1) Q6a1=1$

|-> create; Q16_1=0$
|-> create; if (Q16=1) Q16_1=1$
|-> create; Q16_2=0$
|-> create; if (Q16=2) Q16_2=1$
|-> create; Q16_3=0$
|-> create; if (Q16>2) Q16_3=1$

|-> create; Q17_1=0$
|-> create; if (Q17=1) Q17_1=1$
|-> create; Q17_2=0$
|-> create; if (Q17=2) Q17_2=1$
|-> create; Q17_3=0$
|-> create; if (Q17>2) Q17_3=1$
```

```
|-> create; Q19_1=0$
|-> create; if (Q19<5) Q19_1=1$
|-> create; Q19_2=0$
|-> create; if (Q19=5) Q19_2=1$
|-> create; Q19_3=0$
|-> create; if (Q19>5) Q19_3=1$


|-> sample; all$
|-> reject; Q3a2=0$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 23 bad observations among 198 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .7268355D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -72.68355
Estimation based on N = 175, K = 4
Inf.Cr.AIC = 153.4 AIC/N = .876
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 198, skipped 23 obs
--------+---------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+---------------------------------------------------------------------
--
 REM| .21741* .11410 1.91 .0567 -.00623 .44105
 LOC| .77745*** .15465 5.03 .0000 .47434 1.08056
 BANKCD| .23290 .16076 1.45 .1474 -.08218 .54798
 PICARR| -.29986** .12484 -2.40 .0163 -.54455 -.05517
--------+---------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:06 PM
------------------------------------------------------------------------------
--
```

```
|-> sample; all$
|-> reject; Q3a2=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$
Iterative procedure has converged
Normal exit: 7 iterations. Status=0, F= .1923030D+02

---------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -19.23030
Estimation based on N = 54, K = 4
Inf.Cr.AIC = 46.5 AIC/N = .860
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 54, skipped 0 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 REM| .89920*** .30357 2.96 .0031 .30421 1.49418
 LOC| .44860 .29608 1.52 .1297 -.13170 1.02891
 BANKCD| -.35577 .30871 -1.15 .2491 -.96083 .24929
 PICARR| -.83576** .32936 -2.54 .0112 -1.48129 -.19024
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:08 PM
---------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q6a1=0$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 8 bad observations among 81 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+
```

```
Iterative procedure has converged
Normal exit: 7 iterations. Status=0, F= .2976536D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -29.76536
Estimation based on N = 73, K = 4
Inf.Cr.AIC = 67.5 AIC/N = .925
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 81, skipped 8 obs
--------+---------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+---------------------------------------------------------------------
--
 REM| .06520 .24158 .27 .7872 -.40829 .53870
 LOC| .80548*** .28398 2.84 .0046 .24890 1.36207
 BANKCD| .41253 .29347 1.41 .1598 -.16266 .98772
 PICARR| -.38785 .25454 -1.52 .1276 -.88673 .11104
--------+---------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:09 PM
------------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q6a1=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 15 bad observations among 171 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .6699778D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -66.99778
```

```
Estimation based on N = 156, K = 4
Inf.Cr.AIC = 142.0 AIC/N = .910
-------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
-------------------------------------
Response data are given as ind. choices
Number of obs.= 171, skipped 15 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 REM| .44899*** .12158 3.69 .0002 .21069 .68729
 LOC| .56096*** .13960 4.02 .0001 .28735 .83457
 BANKCD| -.06128 .14890 -.41 .6807 -.35312 .23056
 PICARR| -.43855*** .13807 -3.18 .0015 -.70917 -.16793
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:11 PM
-----------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q16_2=1$
|-> reject; Q16_3=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 4 bad observations among 69 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .2900689D+02

-----------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -29.00689
Estimation based on N = 65, K = 4
Inf.Cr.AIC = 66.0 AIC/N = 1.016
-------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
```

```
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.= 69, skipped 4 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 REM| .59118*** .20673 2.86 .0042 .18599 .99638
 LOC| .52103** .22330 2.33 .0196 .08338 .95869
 BANKCD| -.25005 .23498 -1.06 .2873 -.71061 .21051
 PICARR| -.36503 .23521 -1.55 .1207 -.82603 .09598
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:13 PM
--------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q16_1=1$
|-> reject; Q16_3=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 10 bad observations among 126 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .4941924D+02

--------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -49.41924
Estimation based on N = 116, K = 4
Inf.Cr.AIC = 106.8 AIC/N = .921
---------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.= 126, skipped 10 obs
```

```
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 REM| .22314 .13975 1.60 .1103 -.05076 .49704
 LOC| .64828*** .18245 3.55 .0004 .29069 1.00586
 BANKCD| .23993 .19151 1.25 .2103 -.13541 .61528
 PICARR| -.38511** .15494 -2.49 .0129 -.68879 -.08143
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:15 PM
-----------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q16_1=1$
|-> reject; Q16_2=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 9 bad observations among 57 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 31 iterations. Status=0, F= .1504477D+02

-----------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -15.04477
Estimation based on N = 48, K = 4
Inf.Cr.AIC = 38.1 AIC/N = .794
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 57, skipped 9 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 REM| .33456 .24210 1.38 .1670 -.13994 .80907
```

```
 LOC| 7.94762 387763.5 .00 1.0000 ********** **********
 BANKCD| 7.29479 387763.5 .00 1.0000 ********** **********
 PICARR| -.39251 .24061 -1.63 .1028 -.86411 .07909
--------+-------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:18 PM
-----------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q19_2=1$
|-> reject; Q19_3=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 7 bad observations among 102 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .4723471D+02

-----------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -47.23471
Estimation based on N = 95, K = 4
Inf.Cr.AIC = 102.5 AIC/N = 1.079
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 102, skipped 7 obs
--------+-------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+-------------------------------------------------------------------
--
 REM| .37767** .14893 2.54 .0112 .08578 .66956
 LOC| .60139*** .17205 3.50 .0005 .26418 .93860
 BANKCD| .05555 .17439 .32 .7501 -.28626 .39735
 PICARR| -.17231 .16924 -1.02 .3086 -.50401 .15940
--------+-------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:20 PM
```

```
------------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q19_1=1$
|-> reject; Q19_3=1$
|-> NLOGIT;
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 11 bad observations among 99 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 6 iterations. Status=0, F= .3347481D+02

------------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -33.47481
Estimation based on N = 88, K = 4
Inf.Cr.AIC = 74.9 AIC/N = .852
--------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.= 99, skipped 11 obs
--------+---------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+---------------------------------------------------------------------
--
 REM| .33263** .15826 2.10 .0356 .02244 .64281
 LOC| .51865** .21949 2.36 .0181 .08846 .94884
 BANKCD| .10727 .23120 .46 .6427 -.34587 .56041
 PICARR| -.57464*** .17589 -3.27 .0011 -.91937 -.22991
--------+---------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:22 PM
------------------------------------------------------------------------------
--

|-> sample; all$
|-> reject; Q19_1=1$
|-> reject; Q19_2=1$
|-> NLOGIT;
```

```
 Lhs=choice_f, nij, alt;
 choices=A, B;
 Model:
 U(A)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR/
 U(B)=Rem*Rem+loc*loc+BANKCD*BANKCD+PICARR*PICARR$

+-----------------------------------------------------+
|WARNING: Bad observations were found in the sample. |
|Found 5 bad observations among 51 individuals. |
|You can use ;CheckData to get a list of these points. |
+-----------------------------------------------------+

Iterative procedure has converged
Normal exit: 7 iterations. Status=0, F= .1562290D+02

---------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable Choice
Log likelihood function -15.62290
Estimation based on N = 46, K = 4
Inf.Cr.AIC = 39.2 AIC/N = .853
---------------------------------------
 Log likelihood R-sqrd R2Adj
ASCs only model must be fit separately
 Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
Warning: Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.= 51, skipped 5 obs
--------+------------------------------------------------------------------
--
 | Standard Prob. 95% Confidence
CHOICE_F| Coefficient Error z |z|>Z* Interval
--------+------------------------------------------------------------------
--
 REM| .46589 .30677 1.52 .1288 -.13537 1.06715
 LOC| .99401*** .36948 2.69 .0071 .26985 1.71818
 BANKCD| .17594 .38523 .46 .6479 -.57909 .93098
 PICARR| -.36783 .32150 -1.14 .2526 -.99797 .26230
--------+------------------------------------------------------------------
--
***, **, * ==> Significance at 1%, 5%, 10% level.
Model was estimated on May 27, 2020 at 03:52:24 PM
---------------------------------------------------------------------------
--
```