POLITECNICO DI MILANO

School of Industrial and Information Engineering

Master of Science Programme in Management Engineering

ANALYSIS OF CROWDSOURCING LOGISTICS IN B2C E-COMMERCE:

COSTS AND ENVIRONMENTAL PERSPECTIVE

Supervisor: Prof. Riccardo Mangiaracina

Co-Supervisor: Prof. Angela Tumino

Author: David Bardasco San José

ID number: 10552166

Academic year: 2015-2016

ABSTRACT

Currently, the logistics in e-commerce is one of the big problems, especially in the deliveries between the company and the consumer, as result it generates additional costs that make the online service is not all efficient that it could be. Therefore, the present work focuses on the study of a new practice in the B2C e-commerce logistics, Logistic Crowdsourcing, as well as the creation of a model of costs and emissions about this innovative practice.

To carry out the study about this practice has been made a literature review and the study of some projects of companies that nowadays are offering this service. Later, also it is created a model to calculate the costs and the emissions of the Crowdsourcing Logistics.

Regarding the results, in the analysed articles there are nothing about Crowdsourcing Logistics, that is, there is a gap, even if there are real projects around this practice currently being carried out. This way, it has been possible to define this concept, how this practice is made and the most important players.

About the creation of the model and the related simulations, it can say that the results have allow to extract some interesting conclusions, which allow to understand still better this innovative practice.

So, this paper aims to offer an alternative to current problems in the B2C e-commerce logistics with the Crowdsourcing Logistics and study the costs and the emissions of some hypothetic scenarios with the model created for this practice. And this way understand better the concept and really if it is a good and optimal solution, alternative or not.

Key Words: *Crowdsourcing Logistics B2C Crowdsourcing Logistics, B2C Logistics, Crowdsourcing Last Mile, B2C Crowdsourcing.*

CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

INTRODUCTION

Currently logistics in e-commerce, especially in B2C (Business to Consumer) is one of the main problems, if not the main, because this involved to the companies high costs and in many cases consumers' dissatisfaction. It is mainly for this reason that nowadays it is trying to find, and implement new logistics practices in order to find the right solution that achieves the satisfaction by such retailers as part of end customers.

In this project has chosen to focus and study one of these new logistic practices that are testing and implementing nowadays, specifically Crowdsourcing Logistics. In such a way, to carry out this work and taking into account the scope of this Master in Management Engineering, it has decided to make a review literature in order to see if there is literature about this innovative logistic practice. And then, to analyse if currently there are real projects that are using this practice, it means companies that provide this logistic service. It's a given that this practice could be the future in the logistics of e-commerce. So, it has decided to make a cost and environmental model with the objective to study better this new practice. And obviously, afterwards makes simulations with this and extracts conclusions.

In conclusion, it can say that the main purpose of this project is to study the practice of Crowdsourcing Logistics through the analysis of literature and the study of real cases, that is companies that currently are operating this logistic service. On the other hand, make a costs and environmental model in order to analyse these two aspects about the practice. Following to analyse the model created, have been studied different scenarios with the finality to extract conclusions about this innovative service. And then of this, it has seen and decided if the model is coherent or not.

JUSTIFICATION

This project has been made in order to carry out the Master's Final Project and to obtain the Master in Management Engineering.

The reason has taken to make the project about this topic, mainly arises from four reasons, which are:

- First, my affinity around the logistics and different aspects related with this. Also and in relation with this that in the future I would like to work in a position related with this area.

- The second is the idea of the project offered for the professors, which I consider that is very interesting and clearly could be the future in the B2C e-commerce logistics. So, this has been a great motivation to carry out this project.

- The third reason is because I am a regular user of e-commerce. It means that the problems that currently there are in this business model, I have been able to live and feel these in first person, as well as the consequences of these.

- Finally, I believe that the sector of e-commerce is a very powerful and has a great present and future. So, to find a solution for one of its main problems could be vital for the development and future as much the B2C e-commerce as the society. Moreover, the cited practice hasn't still been made known in lots of countries and neither has taken advantage of this. So, it means that these facts give more possibilities of to increase the use of this practice.

OBJECTIVE AND SCOPE

In the realization of this project have wanted to achieve a number of objectives, which following are detailed:

- To develop the main acquired skills and abilities during the Master.

- Getting to make a project the most realistic possible based on the main motivations, which have been described previously.

- Understanding the practice of Crowdsourcing Logistics and be able to identify the different stages that involves this, as well as all that it requires to carry out.

- Be able to do a literature review about the appropriate field (logistics) and to see if there is literature about Crowdsourcing Logistics or not. Also, to identify the main reasons of the logistic problems in B2C e-commerce with the finality to take greater consciousness around them. And to know the different practices that currently are using. So, get familiar with the literature about this field.

- To go in depth around the selected real cases. It means studying and analyse these, and to understand how are operating these projects nowadays.

- Then to analyse the literature and the current projects about the cited practice, be able to make a costs and environmental model about the Crowdsourcing Logistics. And trying to make it, the most real possible.

- To consider different scenarios and to carry out different simulations about the model with the objective to extract conclusions around the practice and to verify if the model is coherent or not.

- Take greater consciousness around the logistics cost and the generated emissions in the B2C e-commerce.

Regarding the scope of the project, it should be noted that this work is mainly focused on a basic and specific review literature, which as mentioned previously and its finality is to identify if the papers talk about the Crowdsourcing Logistics or not, the main practices that are currently used and the main problems in the B2C e-commerce. About the real cases, the objective is to analyse and study to understand the practice and how these offer the service with the finality to be able to make the model. In relation with the model, the objective is to make a costs and environmental model and to see if this are right or not for the cited practise, then to carry out different simulations.

It is out of the scope of this project, some aspects about the model that are cited and told in the hypothesis considered in the model.

1. LITERATURE REVIEW

The objective of this chapter is to do a literature review and basically to see if there are literature about Crowdsourcing Logistic, and to identify the main alternatives and the main problems in the B2C e-commerce.

1.1. INTRODUCTION AND SCOPE OF THE STUDY

Currently, e-commerce is becoming every time more important in the society. Specifically and to context, we can distinguish three types of e-commerce (Nemoto and Visser, 2001), which are: business-to-business (B2B), consumer-to-consumer (C2C) and business-to consumer (B2C). Regarding the datum around the B2C, it can say that although the online sales by retailers are still below 15% in almost all leading countries (Mulpuru, 2013), the average growth per year is increasing quickly. And basically the main reasons for this success are: wide range of products offered (Park, 2012), price competitiveness (Bruce and Daly, 2010), the experience design high quality client (Brugnoli, 2009), choosing the best logistics strategy (Ghezzi, 2012) and the level of high quality service offered by retailers (Wei and Zhou, 2011). Apart from these aspects, which are mainly related to strategy, there are several factors that can help to drive systematic dissemination of e-commerce (Mangiaracina, 2012).

It should be noted that as all, e-commerce has advantages and disadvantages. Focusing on the disadvantages, one of the main of these is the logistics. As Perego et al. (2012) say to choose the best logistics strategy is one of the fundamental engines generally considered the spread of e-commerce. And the main logistics problems are: returns management, timely delivery cycle and order delivery.

The problems mentioned previously, usually are related to the last part of the production chain, it means with the final stage of the supply chain. This concept is known as the problem of delivering the last mile, which is defined as the final step between the business and the final consumer where the purchase is

delivered to the addressee, either at home or at a point collection. Due to its specific structure of delivery, the last mile is considered an expensive section, if it isn't the most expensive in the supply chain. Specifically, the cost of last mile could be between 13% and 75% of total logistics costs (Onghena, 2008). These high proportions are as result mainly of the inefficiencies and bad environmental development. The most important problems of the last mile deliveries usually happen at home delivery, because they require a firm agreement the product has been received or similar procedure. If there is no fixed delivery time, the rate of failure is quite high, because the customer is not at home. So, the package may have to be transported several times until successful delivery. And on the other hand, the fact set a specific delivery time promises the route efficiency. To sump up, among the main problems find in this area, are considered: the high level of delivery failures, which produces additional costs, high rates of empty vehicles and low volume package delivery. All these problems require efficient planning of the route with the objective to generate more profit margins reasonable and necessary to run the system without problems. As also explained Smithers (2007), some retailers say that to make the online purchase brings environmental benefits. From the point of view of consumers also consider that to make online shopping and home delivery is beneficial to the environment because it generates less trips (Royal Mail, 2007).

As regards logistics practices of delivery in the last mile, some projects are carrying out at present with Crowdsourcing, which is still not well known, but it is occurring to know, because among other things it has used in other fields different than logistics, and assessments and the results have been positive.
The term "Crowdsourcing" was mentioned for the first time for the person who is considered the world leader around this term, Jeff Howe (2006). He referred this term explaining the initiative *IStokphoto.* This was a platform on the Internet where you could share images initially by a group of graphic designers, but ended up getting to everyone. Specifically, it arrived there about 22,000 contributors and getting to pay between $ 1 and $ 5 per basic image (the good quality could cost up to $ 40). One of his sentence said: "The labour isn't always free, but it costs a lot less than paying traditional employees. It's not outsourcing; it's crowdsourcing".

In relation with the definition of Crowdsourcing, Jeff Howe (2008) defines it as “is the act of taking a task traditionally performed by a designated agent (such as an employee or a contractor) and outsourcing it by making an open call to an undefined but large group of people. Crowdsourcing allows the power of the crowd to accomplish tasks that were once the province of just a specialized few”.

Later appeared other authors that also gave their own definition to the term (Brabham, 2009; Kazaa, 2011). One of the definitions, that is considered more complete, is suggested by Estella and Gonzalez (2012), who say: “Crowdsourcing is a type of participative online activity in which an individual, organization, or company with enough means proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task. The undertaking of the task, of variable complexity and modularity, and in which the crowd should participate bringing their work, money, knowledge and/or experience, always entails mutual benefit. The user will receive the satisfaction of a given type of need, be it economic, social recognition, self-esteem, or the development of individual skills, while the crowdsourcer will obtain and utilize to their advantage that what the user has brought to the venture, whose form will depend on the type of activity undertaken.”

With respect to the relationship between Crowdsourcing and logistics in B2C e-commerce, that is, the Crowdsourcing Logistics, apparently there aren’t lot of literature about the field. However, in the practice is known that there are some projects that are carrying out around this logistic practice in B2C e-commerce.

1.2. METHODOLOGY

Such as it has told at the first of this chapter, the objective of this section is to do a literature review and to can analyse better the current and existing information about the topic of the last mile delivery in B2C e-commerce.

The methodology used to carry out this review and to can accomplish the objectives is focused in the exploration and the work of qualitative analysis. Specifically and in line with Mangiaracina et al. (2015) is focused in 3 phases:

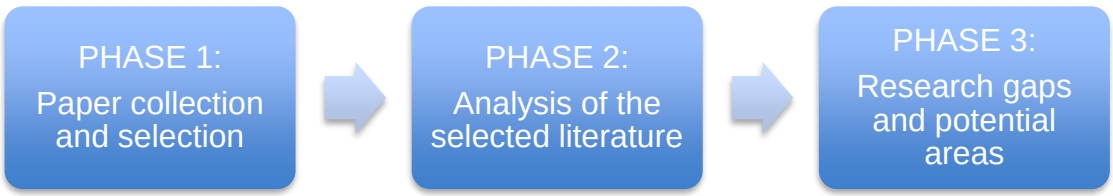


Figure 2: Phases of the Methodology

- PHASE 1: Paper selection and selection

This phase is focused to do a paper collection and to select those that are more appropriated for the aforementioned topic. Following the proposed methodology by Srivastava (2007), the selection process of the papers consist of the next stages:

· Classification context: The context in which is classify the literary material is in the last mile delivery in B2C e-commerce.

· Definition of the unit of analysis: The unit of analysis is defined as a single scientific paper published in an international peer-reviewed journal.

· Collecting of the different publications: The collecting of the literature consists of only papers of international journals which are searched through the next scientific database: Scopus, Emerald, ISI Web of Knowledge and Google Scholar. And this research is carried out mainly with the next key words: "*last mile delivery*", "*B2C*", "*e-commerce*", "*logistic*" and their respective combinations. It is important to say that these key words can appear as much in the abstract of the papers as in the body of these.

· Material evaluation: One time the literature has been analysed and has categorized, in this section carry out a clear classification of the contributions, examined papers and carry through a discussion about the obtained results of the literature review.

· Delimiting the field: The papers and the information are limited to the related relation with the stipulated field that is especially with the Crowdsourcing Logisitics practise. And the relation with the literature can be with the logistic or with some of the key words that they have been considered.

- PHASE 2: Analysis of the selected literature

Following in line with Riccardo Mangiaracina et al. (2015), and keeping the objective of this literature review in mind, the select papers classify it on:

1) Their main characteristics: This is a basic classification (title of the journal where the paper has been published, author, year, first author's country) and the identification of the research method adopted.

2) The main area about which is about the paper.

3) Different criterions about which the papers talk in relation with the main topic.

- PHASE 3: Research gaps and potential areas

Once time that have been done the previous phases, it could already identify gaps where literature doesn't talk and could be future areas of research, study. Therefore , in this sectio will determine those areas where it would be feasible or would be more likely to carry out an investigation in line with the focused objectives and clearly around the determined field.

1.3. SUMMARY OF REVIEW AND DISCUSSION

In line with Natarajarathinam et al. (2009), it has done the Table I with the objective of summarize the basic information of every paper and the research method adopted. And aligned with Perego et al. (2011), the papers are chronological ordered with the finality to show the evolution of last mile logistic issues related to B2C e-commerce over time.

1.3.1. Main characteristics of the papers examined

Next it can observe the main characteristics of the papers examined:

BASIC CLASSIFICATION

No	TITLE	JOURNAL	AUTHOR	YEAR	COUNTRY[a]	RESEARCH MODEL
1	Solving the last mile issue: Reception box or delivery box?	International Journal of Physical Distribution and Logistics Management	Punakivi, M., Yrjölä, H., Holmström, J.	2001	Finland	Simulation
2	Increasing the cost efficiency of e-fulfilment using shared reception boxes	International Journal of Retail and Distribution Management	Mikko Punakivi and Kari Tanskanen	2002	Finland	Simulation
3	Specification for a dynamic vehicle routing and scheduling system	International Journal of Transport Management	Slater, A.	2002	United Kingdom	Math Model
4	Unattended reception - A business opportunity?	International Journal of Services, Technology and Management	Kämäräinen, V., Punakivi, M.	2004	Finland	Interviews
5	Last Mile fulfilment strategy for competitive advantage	International Journal of Logistics Systems and Management	So, H.W.T.a , Gunasekaran, A.b , Chung, W.W.C.a	2006	Hong Kong	Other
6	Last-mile supply chain efficiency: An analysis of learning curves in online ordering	International Journal of Operations and Production Management	Kull, T.J., Boyer, K., Calantone, R.	2007	United States of America	Math Model
7	B2c e-commerce logistics: The rise of collection-and-delivery points in the Netherlands	International Journal of Retail and Distribution Management	Weltevreden, J.W.J.	2008	The Netherlands	Surveys
8	The last mile of e-commerce - Unattended delivery from the consumers and eTailers' perspectives	International Journal of Electronic Marketing and Retailing	Xu, M., Ferrand, B., Roberts, M.	2008	United Kingdom	Surveys
9	Comparative analysis of the carbon footprints of conventional and online retailing: A "last mile" perspective	International Journal of Physical Distribution and Logistics Management	Edwards, J.B., McKinnon, A.C., Cullinane, S.L.	2010	United Kingdom	Math model
10	An adaptive decision support system for last mile logistics in e-commerce: A study on online grocery shopping	International Journal of Decision Support System Technology	Al-Nawayseh, M.K.a , Alnabhan, M.M.a , Al-Debei, M.M.b , Balachandran, W.c	2013	Jordan	Surveys
11	Commonly used e-commerce supply chains for fast moving consumer goods: comparison and suggestions for improvement	International Journal of Logistics Research and Applications	Vanelslander, T.a , Deketele, L.b , van Hove, D.a	2013	Belgium	Math Model
12	Research on mobile communication systems in last-mile logistics to create an end-to-end information flow	International Journal of Services and Operations Management	Petrovic, O., Harnisch, M.J., Puchleitner, T.	2014	Austria	Conceptual model
13	Carbon emissions comparison of last mile delivery versus customer pickup	International Journal of Logistics Research and Applications	Brown, J.R.a , Guiffrida, A.L.b	2014	United States of America	Math Model
14	Hierarchical modelling of Last Mile logistic distribution system	International Journal of Advanced Manufacturing Technology	Aized, T.a b , Srai, J.S.c	2014	Pakistan	Math Model
15	Last mile fulfilment and distribution in omni-channel grocery retailing: A strategic planning framework	International Journal of Retail and Distribution Management	Alexander Hübner, Heinrich Kuhn, Johannes Wollenburg	2016	Germany	Cconceptual model

Table 6: Basic Classification

The total number of analysed papers has been of 15, which were published in 11 different international scientific journals, with a mean value of 1,4 contributions per journal. The papers were published in different types of journals. Specifically, the 73% in logistics and transportation journals and the other in information and communication technologies journals.

About the regions addressed, the number of contributions in which the first author is from Finland is 3 (20%), the same that from United Kingdom that is 3 too. Then, United States of America follows them with 2 publications (13%). The rest of the papers (47%) were written by researchers from other countries, which are: Hong Kong, The Netherlands, Jordan, Belgium, Pakistan, Austria and Germany (all these with only 1 contribution by author of every country). So, talking about the first author's country it can say that Europe is the continent was written more publications (10 papers), followed by Asia (3 papers) and America (2 papers). Also, it has been observed about the authors that Punakivi, M. is the more present authors in the publications, who is present in 3 of the analysed papers and tried to offer a new alternative to Last Mile Logistic.

An in regards to the year of publication, it can be identified two clear periods. From 2001 until 2007, weren't published lots of contributions about the main topic, specifically a 40%. The increase of publications occurred from 2008 until now (2016), where there are the rest of papers (60%). It should be noted that in the year 2014 were where more publications did, followed by the year 2013, 2008 and 2002 with 2 papers every year. The rest of years only carried out one contribute per year. Too it is important to say that the time required conducting a research study, and for a paper to be written, reviewed, and accepted generates that the year of publication of the papers doesn't match exactly with the situation of the moment. But it can observe that in the last years there is an increase of the publications, as a result of the important growth of the e-commerce. So, the increase is ascending, because every time this type of business is more used by the society and obviously it causes news problems and solutions, alternatives that are reflected in all this papers.

1.3.2. Research methods used

The publications are classified and evaluated based on their research methodology. And the main categories used are based on a study by Meixell and Norbis (2008), who identified seven research methods, which are: survey, simulation, interviews, mathematical models, case studies, conceptual models and others.

The 40% (6 papers) of the papers reviewed present math models; follow by surveys (20%), simulations (13%) and conceptual models (13%) and the rest, interviews and others, with one paper everyone.

1.3.3. Themes arising from the review

Next it can observe the classification about the main areas of the papers examined:

AREA CLASSIFICATION

TRADITIONAL SHOPPING MODEL	ONLINE SHOPPING MODEL	LAST MILE (DEFINITION)	LAST MILE PROBLEMS	ALTERNATIVES
Edwards et al. (2010)	Punakivi et al. (2001)	Punakivi et al. (2001)	Punakivi and Tanskanen (2002)	Punakivi et al. (2001)
Aized and Srai (2014)	Punakivi andi Tanskanen (2002)	So et al. (2006)	Slater (2002)	Punakivi and Tanskanen (2002)
Brown and Guiffrida (2014)	Slater (2002)	Xu et al. (2008)	Kämäräinen and Punakivi (2004)	Kämäräinen and Punakivi (2004)
	Kämäräinen and Punakivi (2004)	Edwards et al. (2010)	Kull et al. (2007)	Weltevreden (2008)
	So et al. (2006)	Al-Nawayseh et al. (2013)	Weltevreden (2008)	Xu et al. (2008)
	Kull et al. (2007)	Petrovic et al. (2014)	Xu et al. (2008)	Al-Nawayseh et al. (2013)
	Weltevreden (2008)	Brown and Guiffrida (2014)	Edwards et al. (2010)	Hübner et al. (2016)
	Xu et al. (2008)	Aized and Srai (2014)	Al-Nawayseh et al. (2013)	
	Edwards et al. (2010)	Hübner et al. (2016)	Brown and Guiffrida (2014)	
	Al-Nawayseh et al. (2013)		Aized and Srai (2014)	
	Vanelslander et al. (2013)		Hübner et al. (2016)	
	Petrovic et al. (2014)			
	Brown and Guiffrida (2014)			
	Aized and Srai (2014)			
	Hübner et al. (2016)			

Table 7: Area Classification

1.3.3.1. Traditional Shopping Model VS Online Shopping Model

There are some analysed papers (3 papers) that talk about the difference between the Traditional Shopping Model and the Online Shopping Model. Specifically, in relation with the main topic of this project which is the logistics. Such as say Brown and Guiffrida (2014), the importance of delivery and the supporting logistical process is well recognised in the operations and supply chain literature.

Nowadays every one of these models has a different growth and costs and environment impact in the society. It's obvious that every of this type of model has his advantages and disadvantages too. Following it will analyse what says the literature about these models.

· **Traditional Shopping Model:**

The papers that identify and talk about the Traditional Shopping Model are three. And it should be noted that two of these are connected with the environment topic (n.9 and n.13).

The Traditional Shopping Model is an option of distributing the goods and it is the traditional system with supermarkets and retail shops (Aized and Srai, 2015). When the customers buy with this model, they themselves pick up the purchased item from the retailer and self-delivers the item to the home using their own vehicle (Brown and Guiffrida, 2014). So, as tell Edwards et al. (2010), the customer does most of the labour intensive work, because she/he has to order picking and transport the goods at home. And it is obvious that in this case, the purchase implies to go to the physical location.

About the traditional supply chain, the goods are delivered to store and has been previously cited, the customer picks the items before taking them at home (Edwards et al., 2010).

Therefore, then of see some characteristics of the Traditional Shop Model, it could say that the main advantages and disadvantages of this are:

TRADITIONAL SHOPPING MODEL	
ADVANTAGES	**DISADVANTAGES**
· The customers can see what they are buying and if is necessary they can prove it. · Is better for the company, because this form, it hasn't delivery costs. · The customers can receive help from the shop assistant.	· Is uncomfortable for the customers, because they need to go to the physical shop. · Go to the shop has a cost (time and transport). · Is bad for the environment, because every customer goes to the shop and this generates lots of emissions.

Table 8: Advantages and Disadvantages of Traditional Shopping Model

· Online Shopping Model:

All the analysed papers talk about the Online Shopping Model and every of these contribute different interesting information for the topic of this project.

The Online Shopping Model is another option of distributing the goods that is a system with direct to consumer deliveries (Aized and Srai, 2015). Specifically, as say Brown and Guiffrida (2014), in e-commerce, the item is delivered to the customer by the retail seller or by an agent contracted by the seller to provide a home delivery service. So, the customers can buy without visiting the physical location. Or in line with Edwards et al. (2010), the vast majority of online purchases result in the physical movement of a small package (or single item) to an individual address (typically a consumer's home) by parcel carrier. In general, these deliveries are distributed from local parcel carrier depots and consist of mixed loads in the back of vans. So, in this model the retailers must deliver personalised orders to highly dispersed locations within relatively narrow time window.

In relation with the environment, the Online Shopping Model has yields environmental benefits, because basically it reduces personal travel demand (Edwards et al., 2010).

Xu et al. (2008) say that the ability to fulfil and deliver orders on time could determine an e-tailer's success. Specifically, one of the notable benefits of online shopping is the convenience and time saving when compared to traditional shopping. It includes other factors such as of ease online payment, home delivery and return procedures that all combine to make Internet shopping more convenient than traditional.

The value of the home delivery market has increased rapidly during the last few years. And the most common home delivery model is when the customer can select a time window when the items are delivered (Kämäräinen and Punakivi, 2004).

· Supply chain:

In line with Kull et al. (2007), the current growth and popularity of e-commerce has affected many consumers' everyday lives by providing a wide range of choices, more available information and ease of purchasing. And it should be noted that as companies extend supply chains via direct delivery to consumers, supply chain efficiency depends upon the usability of the online ordering system.

About the supply chain in the Online Shopping Model, Vanelslander et al. (2013) identifies which types of supply chains are the most commonly be found in the online retailing of grocery items in West Europe. And based on this information, there are three types of commonly employed supply chains that are identified, which are:

- Pure player: The companies, which use this model, only dedicate to sell their products by e-commerce. It means they don't have any physical shop where the customers can go to buy their products, because all the actions are by Internet. Inside this model, the main delivery models are:

- Van delivery:

This type of supply chain is used by pure player retailers that carry out the last mile delivery with a dedicated fleet of vehicles. The picking operations are performed in one or more dedicated distribution centres, as well as in providing the dedicated vehicles often places a financial burden on the company employing this type of supply chain setup. And in this model, the cost of last mile delivery is generally very high, because of not having sufficient customer density, as well as having to deal with time-slotted deliveries that are very common with this type of supply chain to provide a high customer service.

- Parcel delivery:

This model employs a parcel carrier's (e.g. UPS, DHL, etc.) from existing distribution network to deliver the goods to the shopper. This enables the retailer to take advantage of a distribution network that converse a large area and already handles large volumes, thus leading to lower last mile delivery costs. Because this type of delivery to the shopper is easily accessible and cost-efficient, many pure play e-commerce actors choose a parcel carrier to bridge the last mile. But the person making the delivery is generally not able to provide the shopper with extra information or value added services. So, this leads to a reduced delivery service towards the customer. And the picking is one or more dedicated distribution centres.

- Click and mortar: The companies, which use this model, dedicate to sell their products by e-commerce and by physical shop. Inside this model, the main delivery model is:

  - Van delivery:

In this model, retailers attempt to leverage their existing distribution network as much as possible. It means that they will consolidate the purchasing of both the offline and online segment. Furthermore, many retailers also opt to do store picking to serve the online shoppers. This way, retailers save the investment in new distribution centres and further utilize the already present stock in store. One of the disadvantages of in-store picking is the “competition” between offline shoppers and order for the same products. This may lead to unexpected stock-outs and therefore to missing items or substitutions in the online orders, as well as frustrated in-store shoppers.

· E-grocery:

The Online Grocery Shopping refers to consumers’ ability to order groceries from home electronically and the subsequent delivery of those ordered groceries at home or any other preferred location.

Regarding to Vanelslander et al. (2013), although e-commerce has been rapidly growing as a sales channel for the past decade, reaching and maintaining profitability has sometimes proven to be difficult. Specially for the segment of the online sales of grocery items, because they are specific properties which complicate their online selling:

- Many grocery items should be kept chilled or frozen. More difficult to deliver to the consumers.

- Margins are generally quite thin, and many online shoppers do not have a high willingness to pay for the convenience of not having to go out to the shop and buy their groceries themselves.

- Grocery items are generally purchased frequently which implies that the ordering and delivery process should be as convenient as possible, as the average shopper will have to go through then many times. However, providing this convenience comes at cost.

And in line with Al-Nawayseh (2013), the main benefits and problems of e-grocery for the customers are:

- Benefits to consumers: better prices, large selection, convenience and time- savings. However, they are worried about: product quality, product delivery, and security and privacy issues.

Specifically, online grocery customers are expecting: high logistical service, demanding convenience, high reliability and timely delivery service. So, retailers must have a balancing strategy that is cost-effective and that meet customers' expectation.

· Advantages and Disadvantages:

Therefore, then of see some characteristics of the Online Shop Model, it could say that the main advantages and disadvantages of this are:

ONLINE SHOPPING MODEL	
ADVANTAGES	**DISADVANTAGES**
· The customers can buy without visiting the physical location. · Has yields environmental benefits, because basically it reduces personal travel demand. · The convenience and time saving.	· Security and privacy issues. · Product quality. · Product delivery.

Table 9: Advantages and Disadvantages of Online Shopping Model

1.3.3.2. Last Mile

In the online shopping model (e-commerce), the logistics is an important and essential factor. For this reason and in line with Al-Nawayseh et al. (2013), the decision to select the best solution to deliver is one of the main challenges that have to decide the retailers when they want to adopt online services.

Regarding the logistics in the e-commerce, the home delivery of online shopping in this type of business is called “The last Mile”. According to Xu et al. (2008), it has been one of the key factors leading to failure lots of online retails, and was and is being a great challenge facing to many retailers. In spite of the convenience and time saving to buy with e-commerce, the inefficiency or failure of the last mile delivery do that the service isn’t so worthwhile.

The different analysed papers, specifically the 60%, say a definition about the Last Mile. Specifically, the authors use different words to define it, but always around the same concepts.

One of this definitions says that the Last Mile is the last stretch of a B2C parcel delivery to the final consignee who has to take the reception of the goods at home o at a cluster/collection point (Aized and Srai, 2014). Specifically, Last Mile focuses on the period when parcels leave the transportation system, that is, the last step in the delivery process. So, it is the link between an online ordering process and physical product delivery. And it involves a set of activities that are necessary for the delivery process from the last transit point to the final drop point of the delivery chain.

An other definition, which is more focused in the logistics, defines the “last mile” in logistics as the last stretch of a business to consumer parcel delivery to the final consigner who hast to take reception of the goods at home or at a cluster/collection point (Petrovic et al., 2014).

Then to define the concept and understand it, some authors have identified different key elements in the Last Mile. About these, Al-Nawayseh et al. (2013) focus on more common elements, which are: the order, the products range, the market demand, the logistical structure, and the logistical infrastructure. However, Hübner et al. (2016) talk about more particular elements of the deliveries, which are: delivery time, velocity, time slot, and delivery area. It is important to understand really good these elements, especially the typical about

deliveries, because they play an important role in the Last Mile. Following some important characteristic about these are briefly told:

- Delivery time: It has an important role on the customers' satisfaction and convenience. And the main goal is to reduce the time that customers wait to receive a delivery while reducing distribution cost and increasing security.

- Velocity: In relation with this factor, the same day delivery presents greater logistical challenges in terms of cost and planning complexity

- Time slot: When the customer can control or select more precisely the desired time slot, the cost for retailers is higher.

- Delivery area: It defines where a retailer offers its delivery service of its e-commerce.

The fulfilment is other factor very important in the Last Mile. It means that the fulfilment process that involves delivering the goods to the customers is an important linkage that affects basically the performance of the supply chain and the customers' satisfaction. So, the strategies about this aspect are considered important in winning the Last Mile advantage (So et al., 2006).

Petrovic et al., (2014) confirm that Last Mile logistics is experiencing an increase in importance throughout the last years. To reflect this fact, they show some datum, which basically are: In Germany 2012, 2,6 billion of shipments were delivered by logistics providers. And that quantitative increased by 3,5% in the last year (2012), as result of the growth of e-commerce with estimated revenues of around 1,3 billion US-dollars worldwide in 2013.

It should be noted that Punakivi et al. (2001) had already said that one of the biggest and main challenges in B2C in e-commerce was the Last Mile. And nowadays the researches and the companies follow focused to understand better the last mile supply chain, because it needs careful investigation in order

to efficiently and economically deliver goods to customers. So, there are lot of opportunities in this field and any optimal solution still find. These opportunities exist in all five components of the customer order cycle: order communication, order entry, order processing, order picking and packing, and delivery (Kull et al., 2007). In relation with these opportunities, there are some authors that speak about these in different areas. But for example, Petrovic et al (2014) talk about the future challenges in the last mile logistics, as result of the increase of the service. Following, are cited these main future challenges, which are:

- Increase of the options for arranged delivery times with delivery window, as result of social changes.
- Optimization of routes for logistics providers.
- More flexibility in the planned delivery.
- Last mile providers will have to study and reduce the inefficiency in rural areas.
- Solutions for the shipments of packages that contain only one product.
- Alternative delivery solution concepts and innovative delivery options.
- Last mile logistics providers will have to try more respectful with the environment, as result of the increase of the service.
- More research about the green logistics.

Next it can observe the main classification inside the main areas of the papers examined:

AREA CLASSIFICATION (II)

LAST MILE PROBLEMS	**High degree of failed deliveries**		**The return of unattended goods**	
	Weltevreden (2008)	Edwards et al. (2010)	Edwards et al. (2010)	Hübner et al. (2016)
	Xu et al. (2008)	Aized and Srai (2014)	Aized and Srai (2014)	
ALTERNATIVES	**Attended Delivery**	**Unattended Delivery**	**Crowd Shipping**	**Click and Collect**
	Weltevreden (2008)	Punakivi et al. (2001)	Hübner et al. (2016)	Weltevreden (2008)
	Al-Nawayseh et al. (2013)	Punakivi andi Tanskanen (2002)		Xu et al. (2008)
	Hübner et al. (2016)	Kämäräinen and Punakivi (2004)		Hübner et al. (2016)
		Weltevreden (2008)		
		Xu et al. (2008)		
		Hübner et al. (2016)		

Table 5: Area Classification (II)

1.3.3.3. Problems in Last Mile Logistic

In line with Brown and Guiffrida (2014), the last mile problem comprises one of the most costly and highest polluting segments of the supply chain in which companies deliver goods to end costumers. But Frazer (2000) already identified that time constraints, poor quality of home delivery services, and lack of variety of delivery options to be the influential factors that make home delivery the weakest link in the Internet chain.

Charantan (2001) reports that non-satisfactory delivery schedule topped the list (34%) of dissatisfaction with e-commerce. It means the importance of delivery for online shopping to the customers. Specifically, the 40% of these prefer easier delivery or collection in addition to cheaper offers and lower delivery charges offered by e-tailers. And a survey of 100 companies conducted by Consignia (2001) revelled that 58% of the respondents ranked delivery at the time and place that is convenient to the consumer as the second most important factor influencing the market.

Aized and Srai (2014) say that the last mile is considered one of the most expensive parts of the supply chain and accounts for 13% up to 75% of the total supply chain costs. Specifically, next to the picking and packing operations, home delivery is the major cost driver in online grocery shopping (Mikko Punakivi and Kari Tanskanen, 2002). To confirm this affirmation, an empirical study (Ring and Tigert, 2001) examining delivery models adopted by grocery retailers in the USA, UK and Europe found that the two killer costs facing pure Internet grocers are the picking costs and the delivery costs.

All these high costs provide an opportunity for companies to achieve substantial efficiencies through optimal planning and proper execution of a delivery plan which may involve analyses to redesign the overall distribution network, establishing more efficient routings, changing delivery zonings, or upgrading to a more fuel-efficient transportation fleet (Brown and Guiffrida, 2014).

Managing this portion of the supply chain (last mile) has been a particular problem from logistics infrastructure standpoint, most notably because of trade-offs between routing efficiency and customer convenience. And to select the method which consumers place orders can have a significant impact on transaction costs and customers service (Kull et al., 2007). So, one of the most difficult problems for logistics management is such a fulfilment process is to solve how to plan and implement a cost effective delivery operation, in a dynamic environment, where commitments to customers must be given while orders are being received (Slater, 2002). In practice however, for many B2C companies, as suggested by Newton (2001), the cost savings promised by e-commerce are eaten up by high delivery expenses.

· Problems:

Some of the analysed papers, specifically 33% (5 papers), talk about the main problems in the Last Mile Logistic and identify them. Basically, these publications define two types of problems in the delivery at home, which are:

- High degree of failed deliveries (Weltevreden (2008); Xu et al. (2008); Edwards et al. (2010); Aized and Srai (2014)):

  The incidence of first time delivery is one of the most common problems in the Last Mile Logistic and it is obvious that it causes important extra costs for the companies.

  Such as say Xu et al. (2008), the most traditional delivery option used by many retailers for home shopping is using courier and postal services. Ant the delivery time varied including same-day, next day and multi day delivery. It should be noted to that many parcels do not fit through mail or letterboxes or require consignee signature, which implies that customers need to be at home when the parcel is delivered (Weltevreden, 2008).

  The problem is that the most common for people is not to be at home during the working day. So, they are not at home when the most home

deliveries are made (Edwards et al. 2010). Talking about some dates, the working households increased by 22% between 1992 and 2006. It means, the incidence of failed deliveries has increased and nowadays follows the same direction, because every time people use more e-commerce and it increases home deliveries. A survey shows that 34% of the respondents indicated that the best delivery time slots from them would be between 6 pm and 8 pm (Xu et al., 2008). But this isn't a good option, because it creates large demands of delivery for a short busy period, which results in the delivery fleet runs at low capacity for 80% of the day, then at fall capacity for the sent.

And this problem is called "Not at home" problem, because the people is not at home at home time delivery (Xu et al., 2008). And it is considered one of the most critical factors for the success of the home delivery operations, because it causes higher operating costs for retailers and carriers, as result that need to be redelivered or returned the packages to the sender and then repeat another time all the delivery process. And also, inconveniences to customers that lead to lower satisfaction, because they don't have their purchase when they want. So, the broken promises and unmet expectations of last mile e-commerce left both consumers and investors dissatisfied. For these reasons, it is working to find alternatives solutions to try to resolve this problem.

- The return of unattended goods (Edwards et al. (2010); Aized and Srai (2014); Hübner et al. (2016)):

The incidence of return of unattended goods is other of the most common problems in the Last Mile Logistic and it is obvious that it causes important extra costs for the companies.

Customers return items for a number of different reasons. Typically between 25 and 30% of all non-food goods bought online are returned compared with just 6-10% of goods purchased by traditional shopping methods (Edwards et al., 2010).

According to Hübner et al. (2016), one of the drawbacks of online shopping is the customer's inability to see and feel the product before purchasing it. Especially in online grocery this becomes a common factor as consumers have general reservations about the retailer selecting and touching their food and consumer about the quality.

About how resolve this problem, it depends of the type of company. It means, in grocery stores the retailers can offer to customers a money-back guarantee, check and return at reception, return by CEP delivery, or acceptance and refunding (Hübner et al. (2016)). And in other industries, the typical return channels are: return items to a physical store or send items back through the standard postal service. And between these channels, approximately half of returns are via carrier collection and half by post (Edwards et al, 2010). It should be noted to that some delivery companies offer an other channel, and it consists to send vans on separate pick-up runs dedicated solely to collecting returned items.

It is important to say that there are some companies that allow choose the customers, which will be the return channel, that use. But it only makes more complex the situation, because the retailers have to manage more services. And it is obvious that all these generate important extra costs for the retailers. For these reasons, it is working to find alternatives solutions to try to resolve this problem.

It should be noted that apart of these that are the main problems, Aized and Srai (2014) talk about two more, which are: High degree of empty running of vehicles and low volume of delivery goods.

1.3.3.4. Alternatives Models to Last Mile Logistic

Then of analysed all the publications, some alternatives models to Last Mile Logistic have been identified with the objective to solve the different problems in

Last Mile and to try to offer more possibilities to the final customer. Basically, two alternatives are:

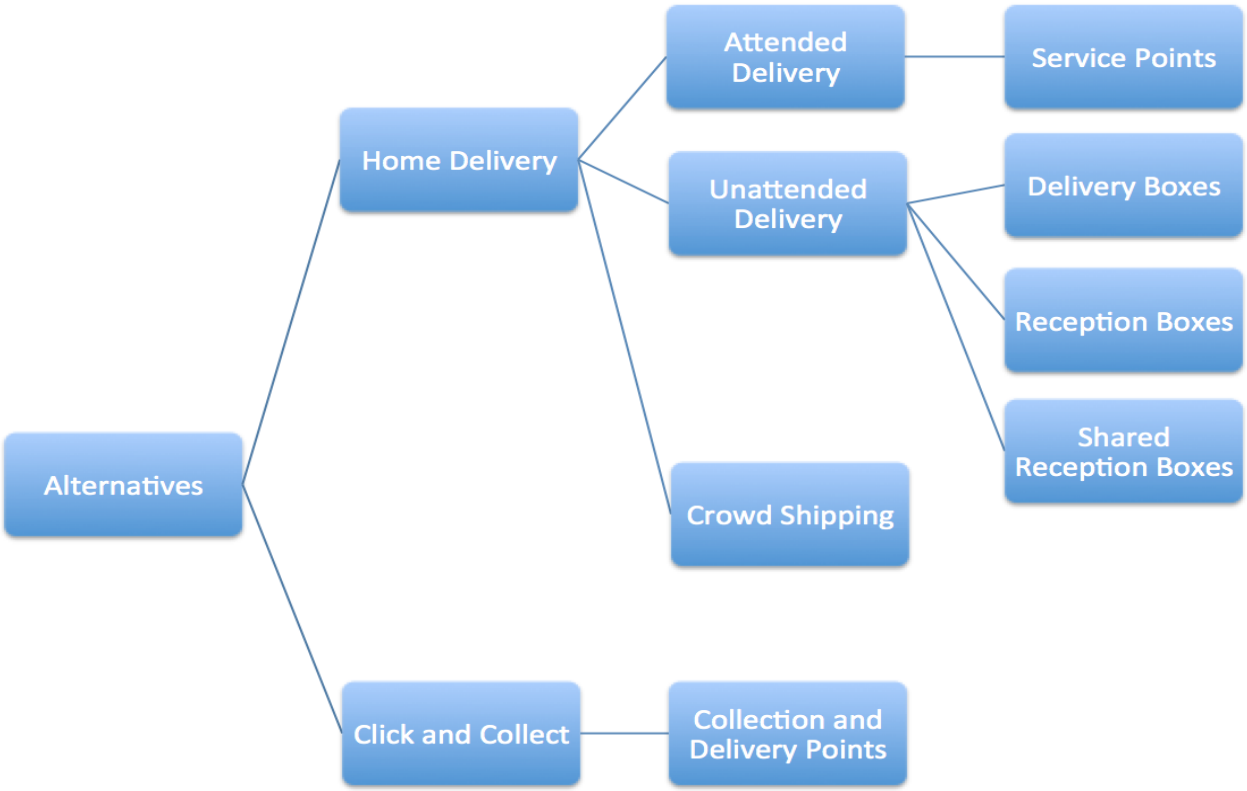


Figure 2: Diagram of Alternatives

· Home delivery:

This concept is focused in that goods are delivered to the store and customers perform the picking and final delivery to their home themselves. So, home delivery concept provides additional customer satisfaction.

The direct concept offers consumers two models: an attended model of reception and unattended model of reception.

- Attended Delivery (Weltevreden, 2008; Al-Nawayseh et al., 2013; Hübner et al., 2016):

  The 20% (3 papers) of analysed papers talk about the attended delivery.

According to Al-Nawayseh et al. (2013), the attended delivery is the attended home reception where customers usually choose the delivery place and time window to receive their delivery within it. So, this model implies that the customer has to be at the point of reception within the time window that she/he has selected to accept the delivery and it implies that she/he is waiting for her/his delivery.

On the other hand, one of the retailers' objectives is maximizing vehicle utilization and minimizes transportation costs to get a certain level of customers' service and the satisfaction of these. And it requires dynamically assigning delivery time slots as new orders arrive and the dynamically creating and adjusting delivery routes (Hübner et al., 2016). It means the vehicle routing becomes more complex, because it has to due to customers' time restrictions and it is obvious that it generates costs.

Analysing the problems about this delivery model, basically there are two big problems, which are:

- The high demand on certain windows might complicate the service, because is possible that the provider cannot make all the deliveries at the same time, so it generates capacity problems.

- The problem of failed delivery: It has been told in the previous part. It means that the customer is not available for order the reception when she/he had said, and as result the truck returns without fulfilment and all the problems that it implies.

In spite of this complexity that this model generates for all participants, the attended delivery model is used for home delivery of grocery goods across Europe regardless of market proliferation

(Hübner et al., 2016). Specifically, in most countries, this model accounts for the largest share of last mile deliveries.

One alternative practice of attended delivery is the **Service Posts**, which following is told:

- Only one of the analysed papers (Weltevreden, 2008) talks about this alternative practice to last mile delivery.

  This alternative consists in that the parcels are delivered to a store, petrol station or post office where customers can pay, collect and return their parcel. Specifically, Weltevreden (2008) defines it as a shop in shop concept. It should be noted that at a service point, the persons who manage the collection procedure are the shop assistants.

  This practice offers some opportunities, which can be positive for all the parts. The Service Points are often located in a store and it means that is combined the collection of the parcels with other shopping activities. So, it can offer retailers prospects of a revenue increase. And it is really good too for the delivery companies, because this way they can combine the delivery of parcels with the regular supply of the shops.

- Unattended Delivery (Kämäräinen and Punakivi, 2004; Xu et al., 2008; Hübner et al., 2016):

The 20% of analysed papers talk about the unattended delivery.

In line with Xu et al. (2008), the original concept of unattended delivery is simply leaving an item on someone's doorstep, or in the garden shed. So, in this model retailers can deliver online purchase of whether the customer is at home or not, because the shopping basket

is place in front of the customer's home to be collected when she/he arrives.

Kämäräinen and Punakivi (2004) with their simulations suggest that this delivery model reduce home delivery costs considerably, specifically by up to 60%. But the problem is that this hasn't been widely used, because it requires investments and commitment from the customer. For the other hand, Hübner et al. (2016) say that the cost of delivery can be reduced by up to 40% compared to attend home delivery with a reception box for unattended home delivery.

The main problem of this is that it brings many security concerns particularly when items are perishable or have high value. But it is a really good option to solve the problems of home deliveries fail, because in 50-60% of households no on is at home during the normal workday an average of 12% of home deliveries fail (Hübner et al., 2016).

This delivery model has different advantages. Talking about the logistics, this eliminates tight time slots and capacity problems resulting from uneven demand during working hours. It means that demand peaks are evened out. And unattended reception shortens the working hours for the distributor. So, it eliminates the redelivery cost when the customers are not at home at their selected delivery time slot. It is important to say to that normally retailers that follow this model will charge additional fees if the customer is not able to receive their delivery in the agreed time slot.

The most common alternative solutions for unattended reception are:

- **Delivery Boxes:**

  This practice is focused on the use of insulated box containing the goods is delivered to the customer and attached securely in a

locking device bolted on the building wall. Then the empty boxes are collected on the day following delivery or later. So, basically the delivery boxes are insulated boxes with a docking mechanism that are returned to the retailer. And there are 2 ways to pick up empty box:

- Pick up of the delivery boxes is done at the sect delivery.
- Pick up of the boxes is done separately on the day after delivery.

Regarding to Punakivi et al. (2001), this solution enables a faster growth rat and higher flexibility of the investments, because of a smaller investment required per customer. The drawback is the additional cost of collecting the empty boxes.

- **Reception boxes (Locker Point):**

This solution consists in a collection of lockers. Specifically, the parcels are delivered to the lockers point where customers can pay, collect and if necessary, return their parcel. It should be noted that the locker points employ baggage lockers technology and use PIN codes to control the delivery by the carrier and the collection of the parcel by the customer (Weltevreden, 2008). And usually these boxes are installed in the consumer's home yard or garage.

In line with Kämäräinen and Punakivi (2004) and from point of view in B2C environment, the reception boxes have some advantages, which are: time savings, flexibility, independence of the supplier timetable, no need to carry purchases, decreasing of impulse buying and systematic purchasing. But there are also some disadvantages, which basically are: high investment and limited access to deliver to the boxes in B2C. Specifically, high investment is considered the major obstacle, because the box can

cost between 1000 and 2000 euros depending on the type of box (Kämäräinen and Punakivi, 2004).

It is important say that the reception box is widely seen as a potential home appliance of the future and there are already many manufacturers in the market. However, utilization rate of the reception box is usually poor (Kämäräinen and Punakivi, 2004).

- **Shared reception boxes:**

This solution is focused in usage of shared reception boxes also known as CDP. About the characteristics of the shared reception box unites, these have various amounts of separate locker, and the separate lockers have electronic looks with a changing opening code to enable shared usage of the lockers using a mobile phone (Kämäräinen and Punakivi, 2004). As previously it said, this concept is also known as the automated collection and Delivery Point (CDP). And at the CDP the ordered goods can be stored until the customer is able to collect the delivery.

In line with Mikko Punakivi and Kari Tanskanen (2002), using this concept, the utilisation rate of the facilities would be higher than in the case of customer-specific concepts.

The main problem is the high investment involved in unattended reception facilities could be solve by sharing the responsibility. But there are others factors that affect home delivery transportation costs in this model, which are (Mikko Punakivi and Kari Tanskanen, 2002):

- The capacity of the shared reception box unit, that is, the number of separate lockers.
- The number of separate reception box units.
- The utilization rate of the shared reception box units.

- **Crowdshipping**:

Only there is only one paper (Hübner et al., 2016) that talks about the Crowdsourcing. Specifically, this defines the concept of Crowdshipping, which is as a further, innovative concept of home delivery. But the authors consider that this approach still faces many legal hurdles, as such deliveries may not be as reliable as corporate service providers in terms of theft or fraud.

Regarding to Hübner et al., (2016), despite the fact that this approach is still in its infancy and its practicability are uncertain, crowdsourcing approaches have remarkable innovative strengths, which is why retailers and logistics service providers should not underestimate this upcoming new delivery mode in the future.

· Click and Collect:

This concept consists in that goods are picked up at the store or at a solitary pick up station at another location. The goods are ordered via the online channel and then either picked and packed from a central warehouse inventory or in store inventory and then transported to the pick up location. It is important to say that the customer can pick up the order at her convenience.

About the advantages of this concept and regarding to Hübner et al. (2016), the main is that the customer bears the full cost of fulfilment on the last mile, reducing logistical cost by up to 70%, the retailer still has to deal with a number of other challenges related to product availability and the pricing process.

One alternative practice of click and collect is the CDPS (Locker Points), which following is told:

- **CDPS: Locker Points:**

This practice is focused on that to let customers undertake the last mile to collect their items from a collection point, such as shops that normally open longer then normal shops (e.g. petrol stations), and existing retail outlets. So, this method leverages the existing logistic network that is close to consumer's home (Xu et al., 2008).

This alternative has different benefits, which are:

- To consumers, it is convenient and time saving, because they do not need to be present in order to receive goods.

- To retailers, it could save delivery costs, because delivery value density can be invaded and delivery time can be reduced (driver's waiting time and re-delivery can be minimised).

But to succeed, retailers need to form into logistics partnership with local convenient stores.

In line with Weltevreden (2008), for carriers delivery a package to a CDP after first-time delivery failure may saves time and fuel, as they need not anymore visit a home for a second or a third time to make a successful delivery. In addition, when CDPs are located near residential locations or at areas that already generate consumers' trips little additional travel by consumers will be required to collect a failed delivery. Therefore, by using CDPs product loss and insurance claims can be reduced because unsecured deliveries can be mitigated.

· Advantages and Disadvantages:

Therefore, then of see some characteristics about every alternative, it could say that the main advantages and disadvantages of these are:

ALTERNATIVES			ADVANTAGES	DISADVANTAGES
Home Delivery	Attended Delivery	Service Points	· Is combined the collection of the parcels with other shopping activities. So, it can offer retailers prospects of a revenue increase. · The delivery companies can combine the delivery of parcels with the regular supply of the shops.	· The high demand on certain windows. · The problem of failed delivery.
	Unattended Delivery	Delivery Boxes	· A faster growth rat. · Higher flexibility of the investments.	· The additional cost of collecting the empty boxes.
		Reception Boxes	· Time savings, flexibility, independence of the supplier timetable and no need to carry purchases. · Decreasing of impulse buying and systematic purchasing.	· The high investment. · The limited access to deliver to the boxes in B2C.
		Shared Reception Boxes	· The ordered goods can be stored until the customer is able to collect the delivery	· The high investment. · The utilization rate of the shared reception box units.
	Crowdshipping		· Innovative concept of home delivery. · Its infancy and its practicability are uncertain.	· Many legal hurdles. · May not be as reliable as corporate service providers in terms of theft or fraud.
Click and Collect	Collection and Delivery Points (CDPs)		· To consumers, it is convenient and time saving, because they do not need to be present in order to receive goods. ·To retailers, it could save delivery costs, because delivery value density can be invaded and delivery time can be reduced	· Product availability and the pricing process. · Retailers need to form into logistics partnership with local convenient stores.

Table 6: Advantages and Disadvantages of Alternatives

1.4. CONCLUSIONS

Then to make the literature review, where has analysed 15 papers, the main conclusions about the literature basically are:

- It has seen and identified in the literature that logistics is a real problem in the B2C e-commerce and there are any optimal solution to solve this problem, which implies lots of costs to the companies and problems to the customers.

- It has been the main definitions about the concept of Crowdsourcing and the main authors that talk about this concept. So, it can understand what it means this concept and the tendency, direction about this to put in context.

- It has been able to identify the stage where carried out deliveries of the B2C e-commerce, which is known by the name of the Last Mile Deliveries. And basically, the papers have been classified by their main characteristics and the area about these talk. This way, it has been really easy to study the literature and extract conclusions.

- It has studied the difference between Traditional Shopping Model and Online Shopping Model, with the objective to see which are the advantages and disadvantages of every one. And it has observed that Online Shopping Model has advantages, but has some problems that needs to solve to be the best Model and more used by the customers.

- It has been able to identify the stage where carried out deliveries of the B2C e-commerce, which is known by the name of the Last Mile Deliveries.

- Have been identified which also the main problems in the Last mile deliveries and basically are: high degree of failed deliveries and the return of unattended goods. And all that these problems generate too.

- Have been identified the different alternatives to solve the logistics problems in Last Mile, specifically in B2C e-commerce. Basically, these alternatives are: Service Points, Delivery Boxes, Reception Boxes, Shared reception Boxes, Crowd Shipping, and Collection and Delivery Points. Every of these has been analysed and told. +

- About Crowdsourcing Logistics, it has seen that the papers don't talk about this practice as an alternative to the logistics problems in the B2C e-commerce. Only one of the papers analysed (Hübner et al., 2016) and it should be noted that talks about Crowdshipping, which has part of Crowdsourcing Logistics, but in addition the purchase is made too. So, it isn't well that would want to identify in the literature, because the finality was to find the practice of Crowdsourcing in relation only with the logistics (Crowdsourcing Logistics). It means that there is a gap in the literature about this practice and it could be a field to research.

2. PROJECTS

One time it has done the literature review and has seen that there aren't it about Crowdsourcing Logistics, the objective of this part is see if nowadays there are or not projects about this innovative logistic practice. And then identify, study and analyse the different projects about Crowdsourcing Logistics in B2C e-commerce that recently are making.

2.1. IDENTIFY OF THE MAIN PROJECTS

In this section, it has proceeded to identify projects that nowadays are making in the practise. And obviously, they are projects that used the practise of Crowdsourcing Logistics to do their commercial activity.

To identify the projects, it has made an intensive and specific search through Internet. Specifically, it has used the search engine Google and different key words in order to find the cases. And the established criterions that have had in mind to identify the appropriate projects are that:

1) The company is using the practice of Crowdsourcing Logistics in some of her activities.

2) The company has a business model about the e-commerce, specifically B2C (Business to consumer).

3) The projects that use the Crowdsourcing Logistics with other practice of crowdsourcing, as for example Crowdshipping have been discarded. And the reason of this decision is because this thesis is focused especially in the logistic field and only it wants analyse this aspect.

Afterward to apply all the previous criterions, they have identified a series of projects that evidently they have been contrasted through the study, analysis of

the own web of the project and other sources of information of Internet. All with the objective of to check and to claim that the identified cases know suitably the determined requirements. The projects that have been found are detailed below:

No	TITLE
1	AMAZON FLEX
2	DELIV
3	DOORDASH
4	INSTACART
5	MyWays
6	POSTMATES
7	RICKSHAW
8	SIDECAR DELIVERIES
9	UberEATS
10	UberRUSH
11	ZIPMENTS

Table 10: Projects

2.2. CLASSIFITACION AND SUMMARY OF THE PROJECTS

One time that the projects have been identified, it has proceeded to analyse them. In order to analyse them of the best possible way and to study them suitably, it has carried through different classifications. This form, it can see clearly different key aspects about the projects and can draw convenient conclusions. The classifications are:

1) Basic: It is focused in to determine the basic information of every project that mainly it is focused in two aspects: the project and the company that carry through the project.

2) Of the Crowd: It is based on to define the main characteristics of the Crowd that must have to work in the pertinent project.

3) Deliveries: It is focused in the key aspects in the deliveries which basically are: the pick up, the delivery areas and what the delivery is.

Is important to say that the analysis is carried out of a total of eleven projects.

2.2.1. Basic

Before to process to do the basic classification is very important to know what the companies think about their projects about Crowdsourcing Logistic. So, next it can see how the companies define their projects:

- Amazon defines Amazon Flex, the project about the last mile delivery as collaborative economy in the logistic where the independent drivers deliver parcels.

- Deliv defines its project as a same day delivery service revolutionizing how online and in store customers get their goods.

- DoorDash defines its project as a technology platform that connects local business to people. They aim to make every city smaller by bringing the food for people-faster, fresher, and from farther away.

- Instacart defines its project as a grocery delivery service that delivers in as little as an hour.

- Deutsche Post DHL defines MyWays as a completely new delivery service for people who need parcels delivered where they want, when they want.

- Postmates defines its project as a revolutionary urban logistic and on-demand delivery platform that connects customers with local couriers.

- Rickshaw defines its project as a same day delivery platform that allows any business to schedule deliveries to their customers without the hassle of managing a fleet of cars and drivers.

- Sidecar Deliveries defines its project as a same day service for local business whereby goods, food and flowers were to be delivered to local consumers using its existing pool of drivers.

- Uber defines UberEats as delivers the best meals from favourite local restaurants in 10 minutes or less. It brings customers a meal on demand with none of the hassle.

- Uber defines UberRush as a connection between customers and couriers to make a delivery. Customers can use it to power faster deliveries and returns.

- Deliv defines Zipments as a community base logistics platform providing business and individuals with the fastest, most affordable same day delivery service available.

It is important to say that actually there are two projects that aren't working which are MyWays and Sidecar deliveries.

Next it can observe the basic classification of the studied projects:

BASIC CLASSIFICATION

No	PROJECT	ORIGIN OF PROJECT	COMPANY	ORIGIN OF COMPANY	COUNTRY	TYPE OF COMPANY*	NETWORK OR SERVICE
1	AMAZON FLEX	2015	AMAZON	1994	Seattle, Washington, United States	Multinational	Network
2	DELIV	2012	DELIV	2012	Menlo Park, California, United States	Start-up	Service
3	DOORDASH	2013	DOORDASH	2013	San Francisco, California, United States	Start-up	Service
4	INSTACART	2012	INSTACART	2012	San Francisco, California, United States.	Start-up	Service
5	MyWays	2013	Deutsche Post DHL	1969	Bonn, Germany	Multinational	Network
6	POSTMATES	2011	POSTMATES	2011	San Francisco, California, United States	Start-up	Service
7	RICKSHAW	2013	RICKSHAW	2013	San Francisco, California, United States	Start-up	Service
8	SIDECAR DELIVERIES	2015	SLIDECAR DELIVERIES	2012	San Francisco, California, United States.	Start-up	Service
9	UberEATS	2015	UBER	2009	San Francisco, California,United States	Multinational	Service
10	UberRUSH	2014	UBER	2009	San Francisco, California, United States	Multinational	Service
11	ZIPMENTS	2011	DELIV	2012	Menlo Park, California, United States	Start-up	Service

NOTE:
TYPE OF COMPANY*: In this moment.
NETWORK: Is when the project take part of the logistic network in the own company. SERVICE: Is when the project isn't involved in a network, so it is only to satisfy a customers' necessity.

Table 8: Basic Classification of the Projects

Regarding to the basic datum of the projects, to emphasize that the origin of these projects has place between the year 2011 and 2015. Being the year 2014 when fewer projects carried out, specifically one. However, during the years 2013 and 2015 were when more projects did (3 every year).

As regards at the companies which come from the project, they have been analysed by the type of company that they are in this moment. Specifically, four of these that is a 36% are multinationals companies and the rest are start-ups. And in relation with this aspect, it can observe that the project name and the company name is the same in the case of start-ups. Too is important to say that as well as much Deliv as Uber has two projects, but Deliv bought one of these of a start-up, specifically of Zipments which nowadays still is called of the same name although it is property of Deliv.

Related to the origin country of the companies, ten of these (91%) are from America, specifically from United States of America and only one (9%) is European, specifically from Germany. Being more specific, inside in American companies, the 64% has origin in San Francisco, California.

On other hand, it has identified if the activity of the project is a service or a network. It means that it has considered a network if the project take part of the logistic network in the own company (the company has her products, her warehouses, etc.). And it has considered a service if the project isn't involved in a network, so the activity is only to satisfy a customers' necessity and is the main and unique activity of the company. Then of to analysed this aspect, it can see that more or less the 80% of the projects are service and the rest (20%) are networks following the consideration.

2.2.2. Crowd

Then of to identify, analyse and classify the Crowd about the different selected projects, it can observe that there are series of requirements to can take part of this. These requirements is focused mainly in:

- Be at least the minimum age.

- Have the type of required and permitted vehicle to carry out the pick up delivery and the deliveries.
- Have a phone with determined characteristics.
- Have a series of documents with the requested conditions.
- Be able to have the physical capacity to lift packages of a certain quantity of weight.

It should be noted that to carry through the logistic job (pick up and deliver the customers' purchase) the member of the Crowd receives a reward.

Next it can observe the crowd classification of the studied projects:

CROWD

No	PROJECT	AGE	DELIVERY VIA	SYSTEM PHONE	PHYSICA HABILITIES	REWARD
1	AMAZON FLEX	At least 21 years old	Motor Vehicle (car)	Android	-	18-25$ per hour
2	DELIV	At least 18 years old	Motor Vehicle (car)	Android or iPhone	Be able to lift up to 50 pounds	20-22$ per hour
3	DOORDASH	At least 18 years old	Vehicle (car, motorcycle, scotter, bike) or Walk	Android or iPhone	-	Up to 25$ per hour
4	INSTACART	At least 18 years old	Motor Vehicle (car)	Android or iPhone	Be able to lift up to 30 pounds	Up to 25$ per hour
5	MyWays	At least 18 years old	Vehicle (car, motorcycle, scotter, bike) or Walk	Android or iPhone	-	Customer dedices how much pay
6	POSTMATES	At least 18 years old	Vehicle (car, scooter, truck or bike) or Walk	Android or iPhone	-	Up to 25$ per hour
7	RICKSHAW	At least 21 years old	Motor Vehicle (car)	Android or iPhone	Be able to lift up to 20-45 pounds	18-25$ per hour
8	SIDECAR DELIVERIES	At least 21 years old	Motor Vehicle (car)	Android or iPhone	-	Up to 25$ per hour
9	UberEATS	At least 19 years old	Vehicle (car or bike)	Android or iPhone	Bikers: Be able to lift up to 30 pounds Drivers: Be able to lift up to 50 pounds	20-30$ per hour
10	UberRUSH	At least 19 years old	Vehicle (car or bike)	Android or iPhone	Bikers: Be able to lift up to 30 pounds Drivers: Be able to lift up to 50 pounds	20-30$ per hour
11	ZIPMENTS	At least 21 years old	Vehicle (car or bike)	Android or iPhone	Be able to lift up to 50 pounds	20-22$ per hour

NOTE:
1 pound = 0,45 kg

Table 9: Crowd Classification of the Projects

First of all to emphasize that the range of minimum age to can be member of the Crowd and to make the requested jobs is between 18 and 21 years old. Specifically of the analysed projects, the 45% demand to be at least 18 years old, the 18% demand to be at least 19 years old and the rest demand to be 21 years old.

As regards how the pickups and the deliveries are carried out to the customers basically it can distinguish between motor vehicles (car, van, motorcycle), bike or on foot. The 45% of the projects only allow making their job by motor vehicles, where the car is with difference the most requested. It is important to say that the 55% of the analysed projects allow the possibility of not to use a motor vehicle, it means that their offer the alternative to make the pickups and deliveries by bike or walking. Specifically of this 55%, the 50% of the projects offer the alternative of on foot or go by bike and the other 50% only offer the alternative of go by bike. Anyway there are some projects as for example Amazon Flex that wants to offer opportunities to deliver via bike or on foot in the future.

It should be noted that the vehicle must be property of the member of the Crowd. There are some projects that request some extra requirements as for example, the project of Deliv request to their members of the Crowd that their cars must be of year 2000 or newer and with air conditioning.

To establish communication between the company and the member of the Crowd that is for the member knows where must go to pick up the delivery and where he must deliver it, all the projects use the same medium to receive the orders, the phone. The 91% of the projects allow have an operative system Android or iPhone, anyone of these is valid. However, the unique project that only allows one operative system (Android) is Amazon Flex. With respect to an other interesting datum about this aspect, it should be pointed out that some projects, as for example Instacart demand to the members of the Crowd that have a recent smartphone, it means as minimum a iPhone 4 or Android 4.

With the objective to guarantee a right running and to offer security to their customers, all the analysed projects request a series of documents to the

members of the Crowd which basically they are: have a valid driver's license, an insurance of the vehicle and pass a background check. Some projects request more requirements about this aspect as for example the project of DoorDash which requests at least 2 years of driving experience to their members or UberRush and UberEATS which request at least 1 year.

Some analysed projects request that the members of the Crowd have some physical abilities which they are linked to be able to lift weight. All this with the objective of to move correctly the customers' delivery. Specifically, the 45% of the projects don't request a minimum (or don't think that it is a key aspect) and the rest (55%) consider that it is important. Of the projects that think that this ability is important which are: Deliv, Instacart, Rickshaw, UberEATS, UberRush and Zipments, they consider basically that the couriers that deliver by bike or on foot must be able to lift 30 pounds and the couriers that deliver by motor vehicle must be able to lift 50 pounds.

As regards to the availability of the members of the Crowd is obvious that it always goes in function of the delivery volume that could be and the availability. But all the projects offer big flexibility to their members to choose their work hours. Some of the projects offer blocks of time to work, as for example Amazon Flex which allow choose any available 2,4 and 8 hours block of time to work the same day. Or the project of Rickshaw that allow choose any available 4 and 8 hours block of time to work the same day.

In some of the analysed projects, they request to have a customer service skills to their members of the Crowd. Specifically these projects are: Deliv, Instacart, Rickshaw, Sidecar Deliveries and Zipments.

Also it is important to emphasise that some of the selection process to be member of the Crowd are more demanding than others. It means that in some of these they only request to fulfil the main characteristics that are requested. However, in others as for example in the Deliv project, it carries out an extensive filtering process which includes interviews by video. Or for example, Postmates that does to pass a deliveries test and a personal interview.

Finally, with respect to the reward for the completed jobs, all the analysed projects determine the price of the member of the Crowd per hour and not for parcel. The compensation range is between 18$ and 30$ per hour. But the most common is that company pays up to 25$ per hour (55%). Only there are two projects (UberEATS and UberRush) where the company could pays more (up to 30$ per hour) and they are of the same company, Uber. It is important to emphasise the case of MyWays which allows at the customer to decide how much will pay for the service. Then the company take a part of this quantity, specifically a 10% and the rest is for the member of the Crowd. Other aspect important about MyWays in difference with the other projects is that pays in Kronas, because it carries out in Stockholm (Sweden) and the other projects pays with dollars.

2.2.3. Deliveries

Next it can observe the deliveries classification of the studied projects:

DELIVERIES

No	PROJECT	WHAT IS THE DELIVERY?	PICK UP DELIVERY	DELIVERY AREA
1	AMAZON FLEX	Amazon Packages, Ultra-Fast Amazon Prime Now Packages	Local Restaurants or Stores	Seattle, Richmond, Nashville, Portland, Raleigh, Virginia Beach, Austin, Dallas, Baltimore, Miami, Atlanta, Houston, San Antonio, Las Vegas, Phoenix, Minneapolis/St. Paul, and Indianapolis metro areas.
2	DELIV	Goods and Food	Local Stores	Atlanta, Boston, Chicago, Dallas, Honolulu, Houston, Las Vegas, Los Angeles, Miami, Northern New Jersey, Orange County, Philadelphia, The New York City metro area, San Francisco and the surrounding Bay Area, Seattle and Washington, DC..
3	DOORDASH	Food	Local Restaurants	Atlanta, Boston, Chicago, Dallas, Denver, Houston, Indianapolis, Los Angeles, Minneapolis / St. Paul, Manhattan, Brooklyn, Orange County, Phoenix, San Diego, San Francisco, San Jose / Silicon Valley, SF East Bay, Seattle / Bellevue, Toronto, Vancouver, and Washington, D.C.
4	INSTACART	Food	Local Stores	California, Colorado, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Oregon, Pennsylvania, Texas, Virginia, Washington.
5	MyWays	Parcels from DHL	DHL Service Point	Stockholm.
6	POSTMATES	Goods and Food	Local Restaurants or Stores	San Francisco Bay Area, New York City, Los Angeles, Sacramento, Chicago, Washington DC, Seattle, Boston, Philadelphia, Miami, Atlanta, Denver, Las Vegas, San Diego, Orange County, Long Beach, Portland, Phoenix, Austin, Houston, Dallas, San Antonio, Minneapolis, Charlotte, Nashville and Virginia Beach.
7	RICKSHAW	Goods and Food	Local Restaurants or Stores	San Francisco.
8	SIDECAR DELIVERIES	Goods and Food	Local Stores	San Francisco, Seattle, Oakland/Bay Area, Chicago, Los Angeles, Boston, San Diego, Washington, Long Beach, Charlotte.
9	UberEATS	Food	Local Restaurants	In areas of: Atlanta, Austin, Chicago, Dallas, Houston, Los Angeles, New York, Paris, San Francisco, Seattle, Toronto, Washington, D.C..
10	UberRUSH	Goods	Local Stores	New York City Area (Manhattan, Brooklyn, Queens, and eastern New Jersey), San Francisco (7X7), and Chicago.
11	ZIPMENTS	Goods and Food	Local Stores	Chicago, San Francisco, New York.

Table 10: Deliveries Classification of the Projects

Then to analyse what the deliver is in every project, the 45% could deliver goods and food, the 27% deliver only food and the 10% could deliver only goods. The rest is the Amazon Flex project and MyWays Project which have an specific delivery about their own company. Specifically, Amazon Flex delivers Amazon Packages and Ultra-Fast Amazon Prime Now Packages and MyWays delivers parcels from DHL.

To sump up it can identify that in the deliveries basically could be: foods or goods. About the food, there is to distinguish between the companies that deliver meal and the companies that deliver food from groceries. Specifically, there are 4 projects that could deliver meal which are: Doordash, Postmates, Rickshaw and UberEATS. The other projects that deliver food are from groceries. About the goods, they could be all type of things that it could find in the local stores.

In relation to the pickups of the deliveries, it could distinguish two main places where make the pickups of the analysed projects, which are: local restaurants and local stores. Specifically, near of 50% of the projects make the pickups in the local stores, the 30% could make these in local stores or local restaurants, the 20% could make these in local restaurants. The case of MyWays is different, because is a special good, so the picks up are only in DHL Service Point. It should be noted that there are some projects that have stores retail partners. Some of these projects are: Deliv, Instacart, Rickshaw and Zipments (In their webs it can see which are the local stores or restaurants).

It is important to say that the pick ups are in local stores and local restaurants, so near from the place where is the delivery, because all these projects are same day delivery. To emphasise that the delivery of UberEATS is curbside delivery, because is the quickest and most reliable way for customers to connect with their messages. So in this project isn’t possible to bring the meal to customer’s door or inside the office.

Regarding to the delivery areas, it is important to say that there are the areas where the companies are working with their projects. About the delivery areas of the analysed projects, the 90% of the projects are working in United States. The

unique project that isn't working in United States is MyWays which only works in Stockholm (Sweeden). To emphasises that there are some projects that are working in Canada (UberEATS and Doordash) and in France (UberEATS). Also San Francisco is the city where more projects are working, specifically the 70% (8 projects).

About the price of the deliveries, all the projects are agree that it depends, varies by the market. For example, the deliveries of Rickshaw start at 5.50$. Or the deliveries UberRush start at 5.50$ within 1 mile and 2.50$ per extra mile in New York.

Finally, some projects have an increment of the service cost with the objective of control the high demand and to offer the best service to the customers, because this way the company can manage better the logistic system. For example Postmates has the Blitz Pricing which indicates that the demand is higher than normal, and deliveries will cost a little more during these peak times. Or Instacart has the Busy Pricing which is a fee that applies specifically to delivery times that are in high demand.

2.2.4. Other Aspects

The customers are very important to all analysed projects. Specifically, the satisfaction and the opinion of these are fundamental aspects, because the customers can help to the company to have a better logistic system.

Some of the studied projects use different ways to value the service received. For example, in the project of Deliv, the customers are invited to rate their Deliv experiences and specifically their drivers, online. Then Deliv only maintains drivers partnerships with those drivers who have a consistent second of timeliness, reliability and positive overall delivery feedback. In DoorDash, there is a score (Doordash Delight score) who is an industry first rating system to help recommend great food and great service to customers. Or in UberEATS, the best way to thank to the driver is with a 5-star rating, because this way he/she will receive more opportunities to deliver.

Other important aspect is the possibility that the customer can follow where is his/her delivery. All the projects try to give facilities to the customers, because they know where is the delivery and when it will arrive at their homes. For example, Instacart get notifications about the status of customer order. With UberRush, the customers can always follow their deliveries from pick up to drop-off (with UberRush real-time tracking).

2.3. CONCLUSIONS

One time that have been analysed the projects (11 projects), it can observe that although the literature doesn't talk about Crowdsourcing Logistic, nowadays there are some companies that are offering this practice. And it is an important fact, because this way it is possible to see if the practice has future or not.

About the different projects has been made an specific and individual analysis, specifically studying the finality of the project, the basic information about the project, the Crowd, information about the deliveries and other aspects that have been considered important. And it can see that every project has his distinctive features, but the main direction, finality in all these is the same, which is to offer a new solution logistic to the customers using Crowdsourcing.

After to analyse the different ways of how work every selected project, it can conclude that the majority of these projects work the next way:

1) The customer buys through e-commerce to local stores or local restaurants and selects the Schedule of the delivery.

2) The member of the Crowd is reported by App that has to do a delivery and where he/she has to pick up and to deliver.

3) The member of the Crowd picks up the delivery at a local store or local restaurant.

4) Finally, the member of the Crowd delivers the items to the customer.

It should be noted that depending of the project, the pickups would change of place, because the customers would buy in other types of shops or restaurants. But the logistic idea is the same.

And now it can see a picture to try to understand better the concept of Crowdsourcing logistic in relation with the studied projects and in relation to the told points about how these projects work:

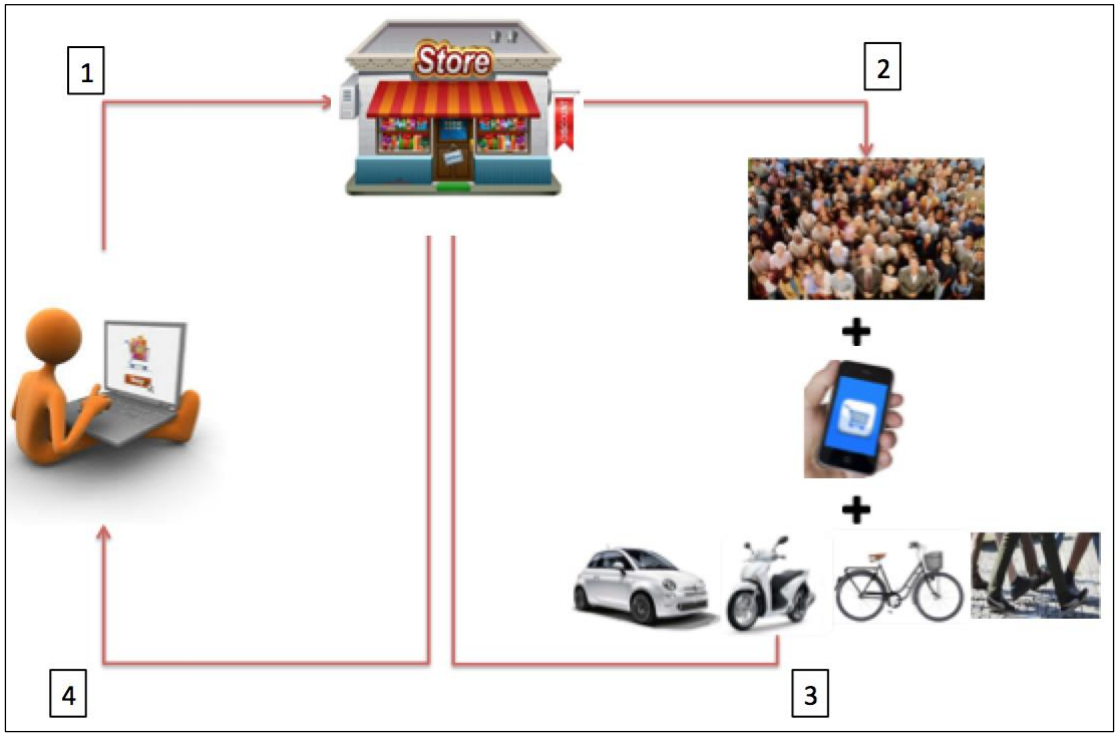


Figure 3: How Crowdsourcing Logistics works

Finally, then to the analysis of literature and the study of actual projects, and after having a vision about these two aspects, it has been able to proceed to develop its own definition of Crowdsourcing Logistics, which has been defined as a service offered by specific members of society that are the Crowd and their basically function is to pick up and deliver packages. It means that they are urban messengers that are working in exchange for a certain reward.

3. MODEL

Then to analyse the literature and the real projects about Crowdsourcing Logistics, in this chapter the objective is to make a costs and environmental model to study and analyse this practice from these perspective.

3.1. Objective

One of the main objectives of the present work is to create a model that allows calculating the costs and the emissions of Crowdsourcing Logistics. So, the objective of the model is that can calculate as real as possible the cost and the emissions of the service of Crowdsourcing Logistic. And all this from the point of view of a company.

But this requires some information about the company and the actually situation to try to do the model as real as possible. Specifically, the company has to enter the next information:

· About the Member of the Crowd: The location of the Member of the Crowd (coordinates), the type of transport that she/he used to make the deliveries and if it is a motor vehicle, the type of fuel that it uses.

· About the Shops: The coordinates of the local shops that are partners of the company.

· About the Deliveries: The customers' name, the local shop where these have bought the things and where it must been delivered (coordinates), and the weight of the delivery.

Then with all this information, the model calculates the next:

· Routes: First of all, the model says that is the nearest Local Shop that the Member of the Crowd has. Then it shows the optimal route that the Member of the Crowd should follow to deliver all the deliveries to the costumers of the selected shop. And basically it depends on the distance

from the Local Shop to every customer and of the weight of the delivery, because every transport has a capacity.

·Cost: The model says that is the total cost of the logistical service (Crowdsourcing Logistics) for the company in function of the characteristics of the Member of the Crowd. And basically it shows the main costs of this, which are: Unit Cost of Acquisition (Pick up Cost and Deliveries Cost), Information and Control Cost, Cost of Launch of the service and Breakage Cost.

· Emissions: The model says that is the total emissions of the logistical service (Crowdsourcing Logistics) with the chosen transport and the determined routes.

3.2. Context

It should be noted that to carry out the creation of the model is necessary to answer and fix some aspects that are basic in the previously cited practice. These are:

· Who buy the service?

Then to analyse different projects about Crowdsourcing Logistics, it has been observed that almost cases the service was bought by Local Shops. So, in the proposed Model, the Local Shops will buy the service, because nowadays the projects are focused in this system.

About the Local Shops and in relation with the topic of this project (Crowdsourcing Logistics in B2C), it has been considered in the model that the Local Shops used to sell the traditional method and e-commerce. It should be noted that with the e-commerce and with this new logistic service the final customer could receive his purchases at home without have to move of his house.

· Who is the service provider?

Then to analyse different projects about Crowdsourcing Logistics, it has been observed that almost cases the service provider are start-ups. Specifically, the start-ups are born to satisfy the customers' logistic necessities. So, in the proposed Model, the service provider is a start-up, because nowadays the most projects come from this type of company.

· Who makes the delivery?

The delivery will make by the Crowd. The Crowd is a number of people that want to do this logistic service, offer their skills for this and have the characteristics and the requirements that are necessary for every company.

Then to analyse different projects about Crowdsourcing Logistics, it has decided that in the proposed Model the Members of the Crowd have the most common characteristics and skills of all the studied projects. Specifically, these are:

· Type of transport to make the deliveries: Car, Motorbike, Bicycle or on Foot.
· If the Members of the Crowd make the deliveries with some vehicle, they have to have their own vehicle.
· Be at least 18 years old.
· Have a phone. It could be Android or iPhone.
· Have a valid driver's license, insurance and pass a background check.
· Professionalism and good communication skills when dealing with clients.
· Ability to lift packages that range from 10-25 kg in and out of vehicles, up and down flights of stairs.

3.3. Scope

The scope of the model is delimited basically by the hypothesis establishes, which are:

1) It will be assigned one Local Shop, which will have different deliveries to make to its customers, at one Member of the Crowd. Specifically, it will be assigned the nearest at the Member's of the Crowd location.

2) It is considered that the Member of the Crowd must complete all the deliveries of the Local Shop that has been assigned.

3) There isn't a priority order in the deliveries in the Local Shop. Specifically, the priority order will go in function of the optimal route. To calculate the optimal route has been used Clarke's and Wright's algorithm which is traditional for VRP (Vehicle routing problem) and is used to plan the routes. It has considered convenient to use this algorithm, because in this type of service the done distance is fundamental, basic factor. For this reason, it is very important to select the best route to optimize costs and emissions.

4) It is considered that the demand of the service by the Local Shops is produced all at the same time (in the same hour). For this reason, every Member of the Crowd has to go to one specific Local Shop, because the first delivery of every Local Shop is more or less at the same time.

5) The demand tax of the service of the Shops must be less or equal than the number of the Members of the Crowd, because if not it won't be possible to provide all the Shops that need the services.

6) The Local Shops and the final customers are in the urban city.

7) The distance is considered in Euclidean distance with the coordinates in Km.

8) The Member of the Crowd can deliver by car, by motorbike, by bicycle or on foot.

3.4. Methodology

The methodology applied to this model is the next:

- First of all, the required data are entered.

- Then, the optimal route is calculated with the attached conditions. And the algorithm use for this is the Vehicle Routing Problem, specifically Clarke's and Wright's algorithm. The resolution of this algorithm (parallel version) is:

- First Step: It is calculated all savings a_{ij} with respect to the deposit for all the customers' pairs "I" and "j".

$$a_{i,j} = d_{i,O} + d_{O,j} - d_{i,j} \longrightarrow a_{i,0} = a_{0,j} = 0$$

- Second Step: To order all the customers' pairs of the biggest savings to the smaller savings.
- Third Step: While there are customers to assign:
  - Select the pair (i, j) that isn't assigned with minor or equal demand at the highest capacity of the route and with the biggest savings.

Cases:

I) If i and j aren't assigned: To open a new route with the extremes i and j.

II) If i is assigned with the extreme of an open route R with a bigger o equal capacity than the demand of j: To assign j a R.

III) If j is assigned with the extreme of an open route R with a bigger o equal capacity than the demand of i: To assign i a R.

IV) If i is the extreme of an open route R and j is the extreme of an open route R', and the sum of the loads of R and R' don't exceed the biggest capacity of the route, merge R and R'.

- One time that the route is calculated, next is applied the costs and environmental model with the formulas, the datum and variables, and the restrictions corresponding (in the next section are told all these concepts).

3.5. Cost Model

Next the cost model is told with his formulas, datum and variables, and the restrictions.

3.5.1. Formulas

The costs that have been considered basically are:

· **Unit Cost of Acquisition (C_u):** This is the cost for the service of **one** member of the Crowd to **one** local shop with all their deliveries that the shop has in that moment.

· **Cost of Launch of the service (C_L)**: This is the cost that implies to launch the service every time that one local shop needs, requires the service of Crowdsourcing Logistics (management, personal, etc.)

· **Breakage Cost (C_B):** This is the cost that implies not to fulfil with the demand of the Local Shops, because there aren't enough Members of the Crowd.

So, the formula to calculate the delivery cost is:

$$C_{Delivery} = C_u + C_L + C_B$$

Units: (€/delivery)

· **Unit Cost of Acquisition (Cu)**: The formula is the next:

$$C_u = C_{pick\_up} + C_{deliveries} + C_{Failed\_deliveries}$$

Units: €/delivery

- C_{pick_up}: This is the cost that implies the Member of the Crowd goes from where she/he is to the nearest Local Shop.
  - C_{pick_up}:

$$C_{pick\_up} = \frac{C_{pick\_up\_Transport} + C_{pick\_up\_Personal}}{E_S}$$

    - $C_{pick\_up\_Transport}$: This is the cost that implies the transport of the Member of the Crowd to the nearest Local Shop.
    - $C_{pick\_up\_Personal}$: This is the cost that implies the required, used time for the Member of the Crowd.
    - E_S: This is the number of deliveries that has to make the local shop that has been selected.

- $C_{deliveries}$: This is the cost that implies the Member of the Crowd goes from the Local Shop to make all the deliveries that the shop has. Also it includes the time that the Member of the Crowd needs to pick up the deliveries in the shop and the time that she/he needs to deliver every delivery to the customer with the correct service.
  - $C_{deliveries}$:

$$C_{deliveries} = \frac{C_{delivery\_Transport} + C_{delivery\_Personal}}{E_S}$$

    - $C_{delivery\_Transport}$: This is the cost that implies the transport from the Local Shop to all the deliveries that the shop has to do.
    - $C_{delivery\_Personal}$: This is the cost that implies the required, used time for the Member of the Crowd.
    - E_S: This is the number of deliveries that has to make the local shop which has been selected.

- $C_{Failed\_deliveries}$: This is the cost that implies to make failed deliveries. It means that the final customer isn't at home, so the MC has to come back to the Local Shop to leave the delivery.
    - $C_{Failed\_deliveries}$:

$$C_{Failed_{deliveries}} = Y_{Failed_{deliveries}} \cdot \left(\frac{C_{Failed_{delivery_{Transport}}} + C_{Failed_{delivery_{Personal}}}}{E_S} \right)$$

- $C_{Failed\_delivery\_Transport}$: This is the cost that implies the transport from the Local Shop to all the failed deliveries that the shop has to do.
- $C_{Failed\_delivery\_Personal}$: This is the cost that implies the required, used time for the Member of the Crowd.
- E_S: This is the number of deliveries that has to make the local shop that has been selected.
- Y_{Fail}:

$\cdot Y_{Fail}$ → 1---------- : If there are failed deliveries.
→ 0---------- : If there aren't failed deliveries.

· **Cost of Launch of the service (C_L)**: The formula is the next:

$$C_L = S_{T\_Deliveries} \cdot C_{Launch}$$

Units: €/delivery

- C_{Launch}: It is the cost to launch the Crowdsourcing Logistics (management, team work, communication, data transfer, etc.).
- $S_{T\_Deliveries}$: It is the number of shops that are partners of the company and need to make deliveries.

· **Breakage Cost (C_B):** The formula is the next:

$$C_B = Y_B \cdot C_{Break} \cdot (S_{T_{Deliveries}} - N_{MC})$$

Units: €/delivery

- $S_{T\_Deliveries}$: It is the number of shops that are partners of the company and need to make deliveries.
- N_{MC}: It is the number of the members of the Crowd.
- C_{Break}: It is the cost to launch the Crowdsourcing Logistics (management, team work, communication, data transfer, etc.).
- Y_B:

· Y_B
- 1---------- : If there are more demand (Shops that need to make deliveries) than Members of the Crowd.
- 0---------- : If there aren't more demand (Shops that need to make deliveries) than Members of the Crowd.

3.5.2. Explanation of datum and variables

The datum and variables that have been considerer in the previous formulas are:

· Car:

· Y_{Car}
- 1---------- : If the transport is by car.
- 0---------- : If the transport isn't by car.

· V_{Car}: It is the average speed of the car (km/h).
· A_{Car}: Amortization and use of the car (€/km).

· Bicycle:

· Y_{Bicyle}
- 1------- : If the transport is by bicycle.
- 0------- : If the transport isn't by bicycle.

·$V_{Bicycle}$: It is the average speed of the bicycle (km/h).
·$A_{Bicycle}$: Amortization and use of the bicycle (€/km).

· Motorbike:

· $Y_{Motorbike}$
- 1----- : If the transport is by motorbike.
- 0----- : If the transport isn't by motorbike.

· $V_{motorbike}$: It is the average speed of the motorbike (km/h).
· $A_{motorbike}$: Amortization and use of the motorbike (€/km).

· On Foot:

· Y_{Foot}
- 1---------- :If the transport is on foot.
- 0---------- :If the transport isn't on foot.

· V_{Foot}: It is the average speed on foot (km/h).

· Fuel:

Petrol:

·Y_{Petrol}
- 1----- : If the vehicle works with petrol.
- 0----- : If the vehicle doesn't work with petrol.

·P_{Petrol}: It is the petrol price (€).

Diesel:

·Y_{Diesel}
- 1------ : If the vehicle works with diesel.
- 0------ : If the vehicle doesn't work with diesel.

· P_{Diesel}: It is the diesel price (€).

· Service Time:

·$t_{s\_pick\_up}$: It is the service time per pick up (min).
·$t_{s\_delivery}$: It is the service time per delivery (min).
·t_{s_Return}: It is the service time to return the delivery (min).

· Transport Time:

·$t_{pick\_up\_transport}$: It is the transport time per pick up (min).
·$t_{delivery\_transport}$: It is the transport time per delivery (min).
·$t_{Failed\_delivery\_transport}$: It is the transport time to return the delivery (min).

· Salary:

· P_{MC}: It is the Member's of the Crowd salary (€/min).

· Distances:

· $X_{MC\text{-}S}$: It is the distance between the Member's of the Crowd location and the nearest Local Shop (Km).
· $X_{S\text{-}D}$: It is the total distance that the Member of the Crowd have to make to deliver the items from the Local Shop to customers (Km).
· X_{Fail}: It is the total distance that the Member of the Crowd have to make to return the items from the failed deliveries to the Local Shop (Km).

· Others:

· E_{Failed}: This is the number of failed deliveries that has to make the MC from the local shop which has been selected.

3.5.3. Restrictions

The restrictions and conditions that have been considerer in these formulas are:

1) Every Member of the Crowd only can make the delivers with one type of transport. It means by car, by motorbike, by bicycle or on foot. So:

$$Y_{Transport} = Y_{Car} + Y_{Motorbike} + Y_{Bicycle} + Y_{Foot} = 1$$

2) About the fuel, it is only necessary in motor vehicles. Specifically, the car is the unique transport that can work with petrol or gasoil, but only with one of this. And the motorbike only works with petrol. So:

$$Y_{Fuel_{Car}} = Y_{Petrol} + Y_{Gasoil} = 1$$

$$Y_{Fuel_{Motorbike}} = Y_{Petrol}$$

$$Y_{Fuel_{Bicyle}} = 0$$

$$Y_{Fuel_{Foot}} = 0$$

3) About the amortization and use, if the Member of the Crowd makes the delivery on Foot, it hasn't any cost of amortization and use, because she/he doesn't use any machine. So:

$$A_{Foot} = 0$$

4) In the cases that have been necessary to calculate the transport time, it has used this formula:

$$t_{Transport} = \frac{X}{V}$$

· X: It is the done distance (km).
· V: It is the average speed of the transport (km/h).

3.6. Environmental Model

Next the environmental model is told with his formulas, datum and variables, and the restrictions.

3.6.1. Formulas

The emissions that have been considerer basically are:

· **Pick Up Emissions (E_{Pick_Up}):** These are the emissions that are generated, because the Member of the Crowd goes from where she/he is to the nearest Local Shop with her/his vehicle.

· **Deliveries Emissions ($E_{Deliveries}$):** These are the emissions that are generated, because the Member of the Crowd goes from the Local Shop to the different places where are the deliveries with her/his vehicle.

· **Failed Deliveries Emissions ($E_{Failed\_Deliveries}$):** These are the emissions that are generated, because the Member of the Crowd can't make the delivery (the customer wasn't at home).

So, the formula to calculate the delivery emission is:

$$E_{Delivery} = E_{Pick\_Up} + E_{Deliveries} + E_{Failed_{Deliveries}}$$

Units: (KgC02/delivery)

· **Pick Up Emissions (E_{Pick_Up}):** The formula is the next:

$$E_{Pick\_Up\_Transport} = \frac{Y_{Transport} \cdot (E_{Transport} \cdot X_{MC-S})}{E_S}$$

This is the formula general and it depends basically on: the type of the transport that the Member of the Crowd uses (type of fuel) and the distance from the Local Shop to all the deliveries that the shop has to do.

· **Deliveries Emissions ($E_{Deliveries}$):**

$$E_{Deliveries\_Transport} = \frac{Y_{Transport} \cdot (E_{Transport} \cdot X_{S-D})}{E_S}$$

This is the formula general and it depends basically on: the type of the transport that the Member of the Crowd uses (type of fuel) and the distance from the Local Shop to all the deliveries that the shop has to do.

· **Failed Deliveries Emissions ($E_{Failed\_Deliveries}$):**

$$E_{Failed_{Deliveries_{Transport}}} = Y_{Fail} \cdot \left(\frac{Y_{Transport} \cdot (E_{Transport} \cdot X_{Fail})}{E_S}\right)$$

This is the formula general and it depends basically on: the type of the transport that the Member of the Crowd uses (type of fuel) and the distance from the failed deliveries to the Local Shop.

3.6.2. Explanation of datum and variables

The datum and variables that have been considerer in the previous formulas are:

· Car:

· Y_{Car}
- 1---------- : If the transport is by car.
- 0---------- : If the transport isn't by car.

· Bicycle:

· Y_{Bicyle}
- 1------- : If the transport is by bicycle.
- 0------- : If the transport isn't by bicycle.

· Motorbike:

· $Y_{Motorbike}$
- 1----- : If the transport is by motorbike.
- 0----- : If the transport isn't by motorbike.

· On Foot:

· Y_{Foot}
- 1---------- :If the transport is on foot.
- 0---------- :If the transport isn't on foot.

· Fuel:

Petrol:

· Y_{Petrol}
- 1----- : If the vehicle works with petrol.
- 0----- : If the vehicle doesn't work with petrol.

Diesel:

· Y_{Diesel}
- 1------ : If the vehicle works with diesel.
- 0------ : If the vehicle doesn't work with diesel.

· Distances:

- · X_{MC-S}: It is the distance between the Member's of the Crowd location and the nearest Local Shop (Km).
- · X_{S-D}: It is the total distance that the Member of the Crowd have to make to deliver the items from the Local Shop to customers (Km).
- · X_{Fail}: It is the total distance that the Member of the Crowd have to make to return the items from the failed deliveries to the Local Shop (Km).

· Emissions:

- · E_{Car_Petrol}: These are the emissions that generates a car that works with petrol.
- · E_{Car_Diesel}: These are the emissions that generates a car that works with diesel.
- · $E_{Motorbike\_Petrol}$: These are the emissions that generates a motorbike that works with petrol.

· Others:

- · E_S: This is the number of deliveries that has to do the local shop which has been selected.
- · Y_{Fail}
  - 1---------- : If there are failed deliveries.
  - 0---------- : If there aren't failed deliveries.

3.6.3. Restrictions

The restrictions and conditions that have been considerer in these formulas are:

1) Every Member of the Crowd only can make the delivers with one type of transport. It means by car, by motorbike, by bicycle or on foot. So:

$$Y_{Transport} = Y_{Car} + Y_{Motorbike} + Y_{Bicycle} + Y_{Foot} = 1$$

2) About the fuel, it is only necessary in motor vehicles. Specifically, only the car can work with petrol or gasoil, but only with one of this. And the motorbike only works with petrol. So:

$$Y_{Fuel_{Car}} = Y_{Petrol} + Y_{Gasoil} = 1$$

$$Y_{Fuel_{Motorbike}} = Y_{Petrol}$$

$$Y_{Fuel_{Bicyle}} = 0$$

$$Y_{Fuel_{Foot}} = 0$$

3) In relation with the previous point, only the car and the motorbike generate emissions, because they work with fuel.

4. ANALYSIS OF THE RESULTS

Then to create the model of costs and emissions about Crowdsourcing Logistics, in this chapter the objective is to simulate with some dates to analyse if it is coherent or not, and to study and understand better the practice in these perspective: costs and environmental (emissions).

4.1. Procedure

First of all, to make the simulations have been used formulas considered and shown in the previous section. For this it has used the tool of Microsoft Office, Excel, specifically through the use of functions and a macro, has suggested the proposed model to obtain the requested datum: the cost and emissions generated by each delivery with the practice of Crowdsourcing Logistics.

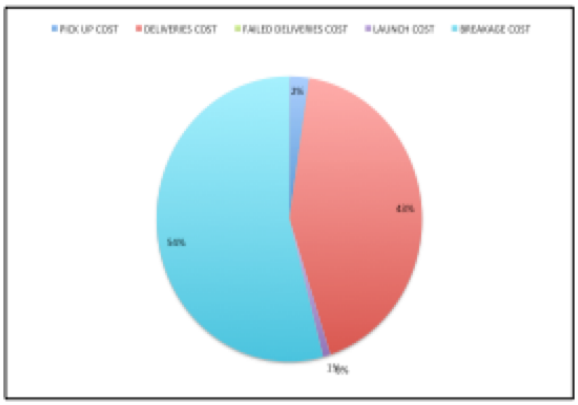
Below it is attached a picture of the main window created for calculating the model proposed, always trying to offer the best possible information:

BASIC INFORMATION					
MEMBER OF CROWD	Where is the member of the Crowd? (Choose)	X	3,89	Y	3,89
	DELIVERY VIA BY/ON (Choose)	CAR			
	TYPE OF FUEL (Choose)	DIESEL			
PICK UP	Local Store	SHOP 2			
	Distance Member of Crowd to Local Store	1,367		Km	
DELIVERY	The MC has to provide	3		customers	
	Distance that MC has to make from Local Shop to all the deliveries	20,05		Km	
FAILED DELIVERIES	The MC has to have (hypoteshis)	0		failed deliveries	
	Distance that MC has to make from failed deliveries to Local Shop	4,86		Km	
TOTAL	DISTANCE	21,417		Km	
	TIME (aprox.)			min	

ROUTES INFORMATION		
If the Member of the Crowd comes back to the Local Shop in every delivery, she/he has to make	23,78	km
The Member of the Crowd needs to transport all the deliveries (capacity, trips)	1	CAR
If the Member of the Crowd makes the optimal route, she/he has to make (it means that she/he only has to come back when has capacity problems)	20,05	km

LOGISTIC CROWDSOURCING		
COST		
PICK UP COST	0,267	€/delivery
Transport Cost	0,176	€/delivery
Personal Cost	0,091	€/delivery
DELIVERIES COST	4,723	€/delivery
Transport Cost	2,586	€/delivery
Personal Cost	2,1367	€/delivery
FAILED DELIVERIES COST	0,000	€/delivery
Failed Transport Cost	0,000	€/delivery
Failed Personal Cost	0,000	€/delivery
LAUNCH COST	0,100	€/delivery
Cost of launch of the service	0,100	€/delivery
BREAKAGE COST	6,000	€/delivery
Breakage cost	6,000	€/delivery
TOTAL COST OF LOGISTIC SERVICE	11,091	€/delivery

EMISSIONS		
PICK UP EMISSIONS	0,043	KgC02/delivery
Transport emissions	0,043	KgC02/delivery
DELIVERY EMISSIONS	0,628	KgC02/delivery
Transport emissions	0,628	KgC02/delivery
FAILED DELIVERY EMISSIONS	0,000	KgC02/delivery
Failed Transport emissions	0,000	KgC02/delivery
TOTAL EMISSIONS OF LOGISTIC SERVICE	0,671	KgC02/delivery



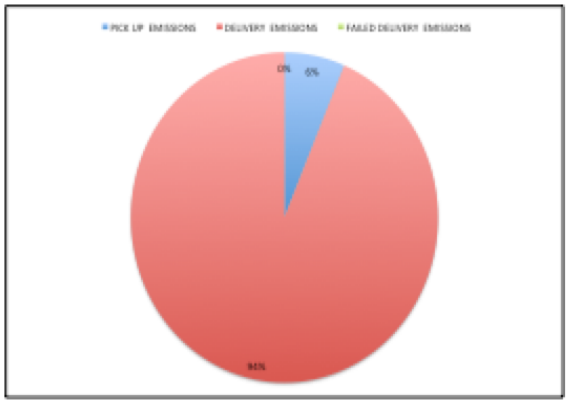


Figure 4: Main window of the created Model (Excel)

To implement the model and the corresponding simulations have been used a number of fixed data, which have been considered by some information and corroborated, and others have been considered by hypothesis. Then it can see the data that have been considered for the execution of simulations:

AVAILABILITY OF THE LOGISTIC SERVICE					SOURCE
Hours	24	hours			
Days	7	days/week			
Days	365	days/year			
VEHICLE					**SOURCE**
Petrol price (P_{Petrol})	1,460	€/litre	0,015	€/km	GlobalPetrolPrices (Web): It is considerated the price in Italy (30-05-2016).
Diesel price (P_{Diesel})	1,290	€/litre	0,013	€/km	GlobalPetrolPrices (Web): It is considerated the price in Italy (30-05-2016).
Car	**Average Speed** (V_{Car})	30	km/h		Hypothesis
	Amortization and use (A_{Car})	0,30	€/km		Hypothesis
	Weight Capacity (W_{car})	50	kg		Hypothesis
Motorbike	**Average Speed** ($V_{Motorbike}$)	30	km/h		Hypothesis
	Amortization and use ($A_{Motorbike}$)	0,10	€/km		Hypothesis
	Weight Capacity ($W_{Motorbike}$)	25	kg		Hypothesis
Bicycle	**Average Speed** ($V_{Bicycle}$)	15	km/h		Hypothesis
	Amortization and use ($A_{Bicycle}$)	0,01	€/km		Hypothesis
	Weight Capacity ($W_{Bicycle}$)	15	kg		Hypothesis
On foot	**Average Speed** (V_{Foot})	5	km/h		Hypothesis
	Weight Capacity (W_{Foot})	15	kg		Hypothesis
CROWD (Member of the Crowd = MC)					**SOURCE**
Courier Salary	13440	€/year			Hypothesis
Courier Salary	960	€/month			
Courier Salary	48	€/day			
Salary Member of the Crowd (P_{MC})	6	€/hour	0,1	€/min	Hypothesis
Number of available MC (N_{MC})	2	members/hour			Hypotesis: It is the estimated number of members of the Crowd per hour block.
SERVICE CHARACTERISITICS					**SOURCE**
Service time per pick up ($t_{s\_pick\_up}$)	3	min			Hypothesis: It is the estimated time that the MC needs to pick up every delivery in the shop.
Service Time per delivery ($t_{s\_delivery}$)	5	min			Hypothesis: It is the estimated time that the MC needs to pick up every delivery in the shop.
Service Time per failed delivery (t_{s_return})	5	min			Hypothesis: It is the estimated time that the MC needs to return the delivery in the shop.
Number of Shops ($S_{T\_Deliveries}$)	4	shops/route			Hypothesis: It is the number of local shops that in this route have things to deliver.
Number of deliveries of the shop	3	deliveries/route			Hypothesis: It is the number of the deliveries that the selected local shops needs to deliver in this route.
Number of Failed Deliveries (E_{Failed})	0	deliveries/route			Hypothesis: It is considerated the number of the failed deliveries that there are in the suggested route.
Number of deliveries that saturate the service	4	Shops with deliveries			Hypothesis
OTHERS					**SOURCE**
Launch Cost (C_{Launch})	0,050	€/delivery·shop			Hypothesis: It is the estimated price of to launch every time the service in one Shop.
Breakage Cost (C_{Break})	3,000	€/delivery·shop			Hypothesis: It is the estimated price of to break the service for one Shop.
EMISISIONS					**SOURCE**
Petrol Car (E_{Car_Petrol})	0,102	kg Co2/km			Hypothesis: Fiat Panda 09 Trekking 85cv TwinAir EU6 (Petrol).
Diesel Car (E_{Car_Petrol})	0,094	kg Co2/km			Hypothesis: Fiat Panda 1.3 Lounge 95CV Diesel E6 (Diesel).
Petrol Motorbike ($E_{Motorbike\_Petrol}$)	0,081	kg Co2/km			Hypothesis: Honda NC750X (Petrol).

Figure 5: Datum considered

To carry out he related simulations has set out a baseline scenario, which it has been changing variables in order to achieve the greatest possible number of data with the different possibilities and can to draw better conclusions. Specifically, for the above scenario the following characteristics has been considered:

- The set ranges of the main variables have been:

    - Number of Members of the Crowd: 2,4,6,8 and 10.
    - Number of shops with deliveries to make: 2,4,6,8 and 10.
    - Number of customers of the most nearly shop from the selected member of the Crowd: 1,2,3,4 and 5.

- The block work of each member of the Crowd is approximately 2-4 hours.

- Simulations have been made for transport 4 considered, which are: car, motorbike, bicycle and on foot. And given that the car has the variant: diesel or petrol.

- To fix the coordinates of each variable that require location, first of all has been considered a delivery area of 5 x 5 km, i.e. 25 km^2. All with the objective that the obtainment of datum was the most realistic and coherent as would be possible. Also, it is important to say that the coordinates have been given a factor of 0.9713, because it has been considered that using Euclidean coordinates was necessary to use a factor, because the streets do not follow that way and sometimes there that deviate from the path.

- It has been considered coordinates for the location of the Member of the Crowd, for the location of the shops and for the location of the customers. And all these has been made completely random and through of function of Excel. And the number of failed deliveries too.

- It has been considered that each transport could bting a certain amount of packages. Specifically, the amounts set has been as follows:
    - Car (whether or not diesel or petrol): 5 deliveries.
    - Motorcycle: 3 deliveries.
    - Bicycle: 2 deliveries.
    - Walk: 2 deliveries.

Obviously, this fact has significantly affected the distances and the route has made the member of the Crowd, because if the transport cannot cover all the deliveries, it means that has to come back to the shop and then go to the other customers.

The basic scenario datum, which has made through Excel, has been the next:

SCENARIO						
MC		SHOPS		CUSTOMERS		Failed Deliveries
X	Y	X	Y	X	Y	Nº
3,89	3,89	0,00	1,94	4,86	0,00	1,00
		4,86	4,86	3,89	2,91	
		0,00	1,94	1,94	0,97	
		0,00	3,89	0,97	0,00	
		3,89	0,00	1,94	1,94	
		0,97	3,89			
		2,91	0,97			
		4,86	0,00			
		0,00	2,91			
		3,89	1,94			

Figure 6: Basic Scenario

And from there, it has raised the following changes of variables to study better the model and thus make a more profound and truthful analysis. Follow, it can see an abstract of all the cases simulated with the different variables:

	CASES						
			A	B	C	D	E
	Nº MC	Nº SHOPS	Nº CUSTOMERS				
CASE 1	2	2	1	2	3	4	5
CASE 2	2	4	1	2	3	4	5
CASE 3	2	6	1	2	3	4	5
CASE 4	2	8	1	2	3	4	5
CASE 5	2	10	1	2	3	4	5
CASE 6	4	2	1	2	3	4	5
CASE 7	4	4	1	2	3	4	5
CASE 8	4	6	1	2	3	4	5
CASE 9	4	8	1	2	3	4	5
CASE 10	4	10	1	2	3	4	5
CASE 11	6	2	1	2	3	4	5
CASE 12	6	4	1	2	3	4	5
CASE 13	6	6	1	2	3	4	5
CASE 14	6	8	1	2	3	4	5
CASE 15	6	10	1	2	3	4	5
CASE 16	8	2	1	2	3	4	5
CASE 17	8	4	1	2	3	4	5
CASE 18	8	6	1	2	3	4	5
CASE 19	8	8	1	2	3	4	5
CASE 20	8	10	1	2	3	4	5
CASE 21	10	2	1	2	3	4	5
CASE 22	10	4	1	2	3	4	5
CASE 23	10	6	1	2	3	4	5
CASE 24	10	8	1	2	3	4	5
CASE 25	10	10	1	2	3	4	5

Figure 7: Cases

In each case those shown has set a number of members of the Crowd, a number of shops that had deliveries and a number of customers in a particular store, which was the one that was closer regarding the location of the member of the crowd. It is important to say that only are analysed deliveries perform a single store by a single member of the Crowd, but it is necessary to consider all the facts, because this affects and have an effect on the final price and emissions of each delivery.

4.2. Costs: Summary and conclusions

Following the simulation procedure cited in the preceding paragraph and with the corresponding model, there have been a total of 25 simulations in relation with the costs that generate every delivery (with fixed data and hypothesis considered). Each of them in turn, with their respective variants (car works with petrol, car works with diesel, motorcycle, bicycle and walking).

In the section Annexes (Results of the simulation), it can see all the results obtained in each case around costs.

After analysing the results, then are emphasised those aspects around costs that are considered most important and relevant to them into account, as well as to draw conclusions about the practice studied (Crowdsourcing Logistics) and the proposed model. And taking into account the characteristics and fixed assumptions, hypothesis.

Costs mainly depend on the distance travelled and the time spent by the member of the Crowd as well as the type of transport.

Analysing the results, it can be seen that by performing deliveries by bicycle or on foot saves on consumption and amortization, but instead in terms of time costs increase. So that the most balanced option is that the member of the Crowd makes the deliveries by motorcycle, since it is the most economical and therefore the most interesting option for businesses and for the realization of Crowdsourcing Logistics.

The cost of delivery is in a range between 2,43 and 38,62 Euros per delivery. Emphasize that much of the cost is in the part of customer's delivery of his purchase, as well as the breaks in service when there are these. As regards the other costs involved in the proposed model, they are practically negligible.

Note that from the perspective of costs, the break of service, i.e. not having sufficient resources (members of the Crowd) generates significant implications in costs and dimensions lot these. In the model created, it has sought to highlight this aspect, for this reason it has been given considerable cost to the fact that has breakages, because it generates customer dissatisfaction and because it is one of the main problems that the practice cited too. This problem cited basically focuses on that if the number of members of the Crowd is less than the number of stores that have to make deliveries, it can not fulfil all the demand and therefore, it doesn't allow to serve to customers, which obviously it is negative. So, from the perspective of costs both the number of members of the Crowd as the number of stores that have deliveries to make, are very important, because they are directly involved with the cost of breakage, which can increase lot delivery costs.

Also, it must say that the bicycle option is a very tempting option and which through simulations has been seen that can play a very important role in this practice, since the costs are very close to the motorcycle, and taking into account which is a clean transport, i.e. not contaminated (the emissions are analysed in the next section). Therefore, it can be a very good alternative to offer Crowdsourcing Logistics with transport by bicycle to the members of the Crowd. But instead it requires more time and the capacity in some cases is a problem, because bicycle can not bring the same deliveries than the car. So in this aspect, is far of this.

Next it can observe the case 1 at the level of costs, where it can see the option of walking in this practice still far away, since this type of delivery is very expensive due to the time required. In this graph can also appreciate the strong threat of bicycles as a clear competitor to the motorcycle, leaving in third place the car, which loses strength. The car is not the most suitable transport for this service, because in the city is hard to go by car. Anyway it remains an important alternative, because it allows lots of deliveries on the same route, since the car is the transport of more capacity that has been set for this practice. In the graph it can see that increasing the number of customers, the delivery costs drop,

which generates that have to squeeze the maximum. All this with the finality of to return the fewest times possible to the store.

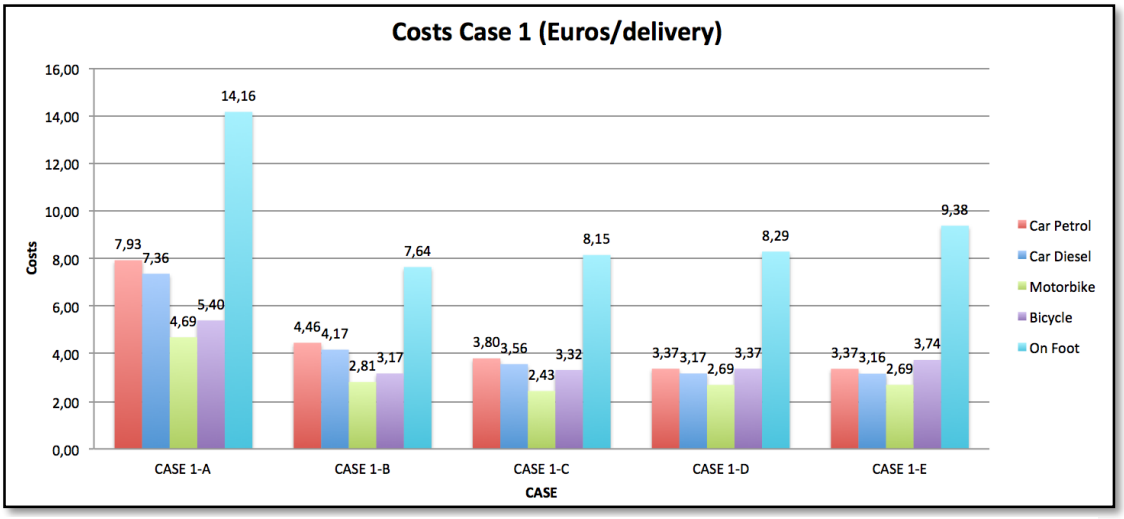


Figure 8: Costs Case 1

With respect to the graph of the case 25, note that follows the same line as above, but with some minor differences, which are linked to the distance.

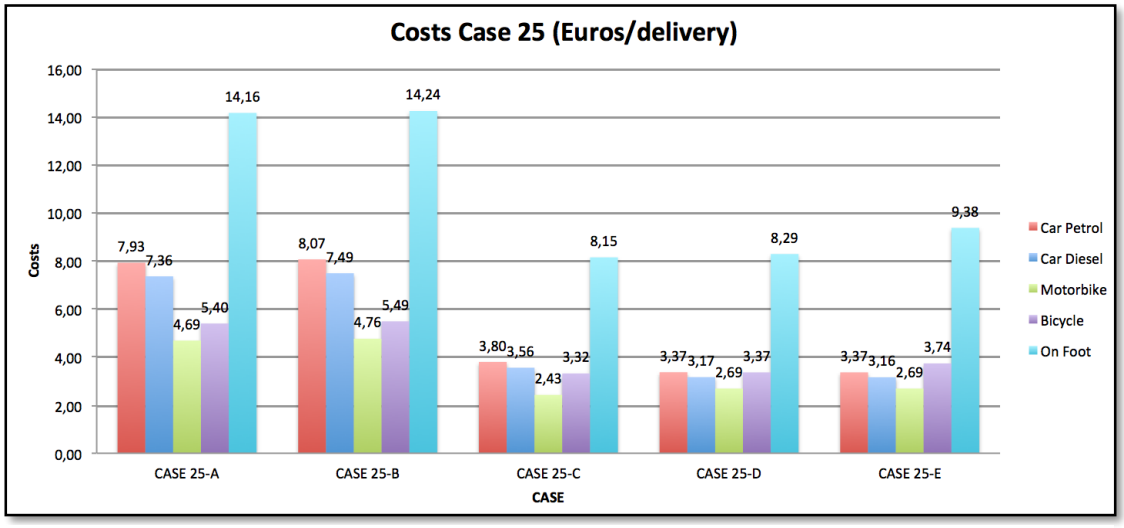


Figure 9: Costs Case 25

In conclusion, it can say that Crowdsourcing Logistics from the perspective of costs is focused on the distance travelled, in the time required and the transport. Not forgetting, breaking service that apart from generating customer dissatisfaction can generate very significant increases in costs. Therefore, after performing simulations, it can say that from this perspective, the model is consistent, since

the results are very similar to the reality (with the limitations of the model). And in turn, it can open the doors to the viability of Crowdsourcing Logistics, because delivery cost is quite similar to the current main competitors and main alternatives.

4.3. Emissions: Summary and conclusions

Following the simulation procedure cited in the preceding paragraph and with the corresponding model, there have been a total of 25 simulations in relation with the emissions that generate every delivery (with fixed data and hypothesis considered). Each of them in turn, with their respective variants (car works with petrol, car works with diesel, motorcycle, bicycle and walking).

In the section Annexes (Results of the simulation), it can see all the results obtained in each case around emissions.

After analysing the results, then are emphasised those aspects around emissions that are considered most important and relevant to them into account, as well as to draw conclusions about the practice studied (Crowdsourcing Logistics) and the proposed model. And taking into account the characteristics and fixed assumptions, hypothesis.

Emissions depend mainly on the distance travelled and of the transport used. Obviously, neither transport by bicycle or walk transportation generate emissions. Therefore, this practice has great potential to be friendly with the environment and does not generate emissions, i.e. not to pollute. So that it can be considered a green practice, because when the members of the Crowd use these types of transport, do not pollute. However, it should be noted that members of the Crowd must travel more large distance and having to use their own body, it takes longer and fatigue by members of the Crowd. Note that in the rest of conclusions that are drawn around emissions has not been talked about bicycle and walk, since it has been considered evident that these do not generate any emissions and therefore, this study is not necessary (in this aspect), because they are the best option (talking about emissions).

When the member of the Crowd must make deliveries to more than three customers, the transport that generates fewer emissions, i.e., the least polluting, is the car, specifically that works with diesel. And this is mainly due to the capacity, because the car can load more deliveries unlike the motorcycle. However, if it must make less than two deliveries and therefore, the member of the Crowd makes the direct transport, i.e. goes from the shop to customers without having to go back to the shop, it is considered that motorcycle is the most appropriate transport (in relation with emissions), generating fewer emissions than a car.

It should be noted that the fact that the number of stores that have deliveries to make or the number of members of the Crowd, has been seen that is not a key factor or that involving changes in the amount of emissions per delivery.

Emissions range are from a value range of 0 to 1,40 KgC02 / delivery. Note that much of the emissions generated are in the part of the delivery of the purchase at the end customer, always that has performed more than one delivery, because it is when the member of the Crowd must travel more distance.

When more deliveries are made, emissions generated by these deliveries are spread and is much more significant than a single delivery.

Following is attached a chart of Case 1, which it can see the emissions generated by the car with petrol, diesel and motorcycle. And it has been changed the number of customers. Also, it can observe that when it just has to make a single delivery, that is, a single customer, emissions are higher than when have to make some deliveries. Therefore, when it must carry out more deliveries, emissions spread and the emission per delivery is reduced. Also, it is important to see the trend, because then it is bogged down more, and in some cases increase again slightly, because the distance and the capacity mark the trend.

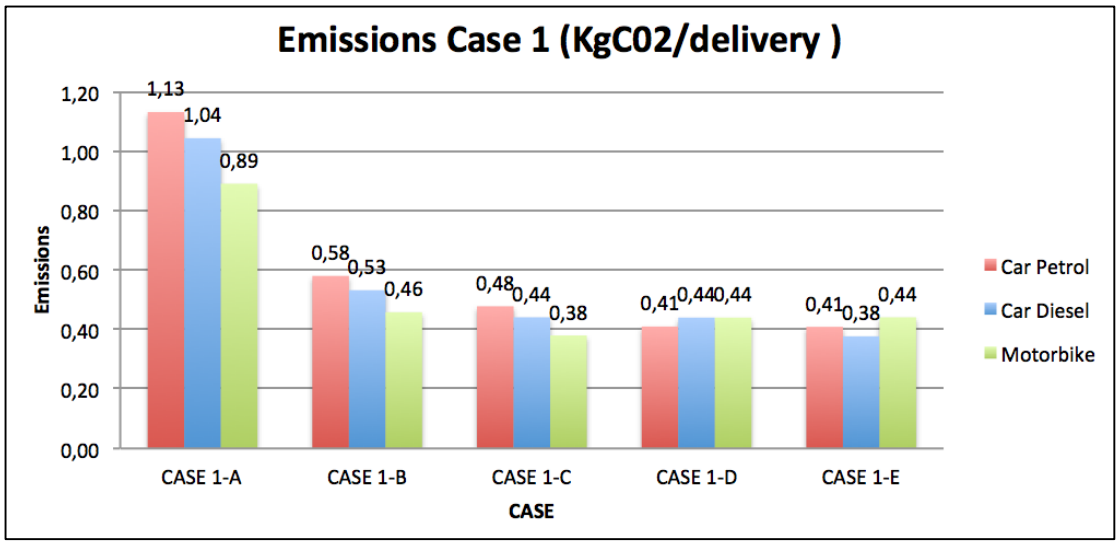


Figure 10: Emissions Case 1

The case 25 follows the same trend as above, and despite to have more members of the Crowd, such as has been said previously, in the model raised this does not affect. Neither a greater number of stores. Therefore, as in the previous case, what marking the trend is guided by the distance travelled and the capacity of the transport.

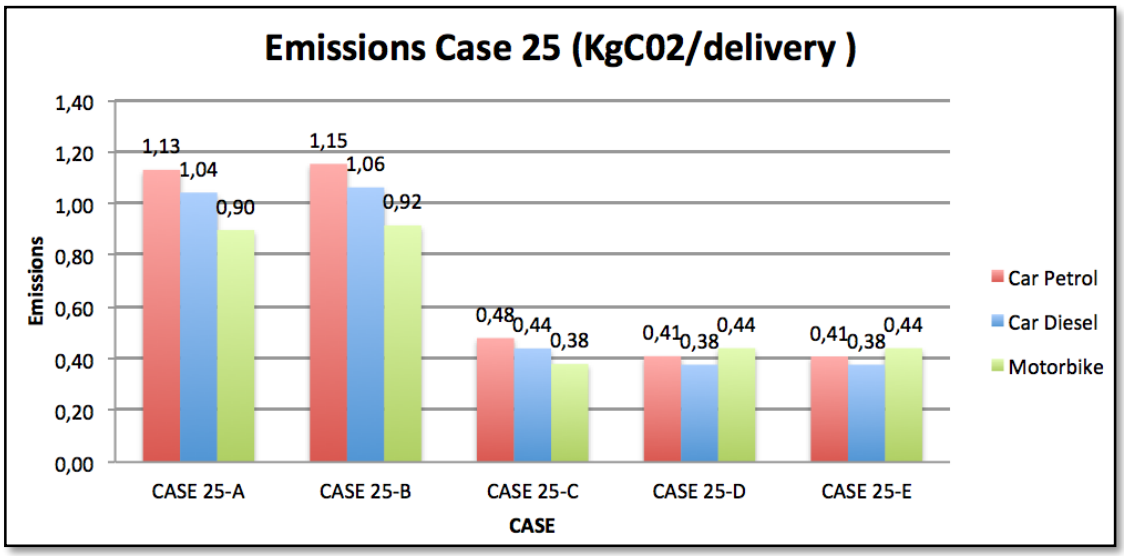


Figure 11: Emissions Case 25

In conclusion, after analysing the proposed model, it can be said that the results obtained are consistent and are mainly governed by the distance travelled and by the transport used, which depending on the emissions that emits is what

determines the pollution deliveries, and in turn of the practice cited. It is important to say the opportunity, possibility to get make a completely clean transport, but on the contrary it implies increased fatigue by the member of the Crowd and more time.

5. CONCLUSIONS

This section explains the different conclusions of this project, which are shown next.

Throughout this project have been developing different abilities and skills acquired during the Master about Management Engineering. Also I have reinforced some concepts and at the same time I have learned new ones.

Respect literature review around the treated field, deliveries in the last mile in B2C e-commerce, it has been made a review and analysis, which has allowed me to become familiar with the basic concepts and definitions. Specifically, the definitions of the term crowdsourcing and last mile. It has been identified the main problems that cause this type of deliveries, and the main alternatives, which are being tested nowadays in order to find an optimal solution to the problem of deliveries in B2C e-commerce. And on this point, it has seen that there is a gap in the literature about the Crowdsourcing Logistics, because although the literature doesn't talk about this as a possible alternative, currently this practice is already in use in some real projects.

Regarding the study of real projects being carried out, it has been noted that several projects in important companies have been focused on offering this service to clients. Specifically, it has been analysed each project and basically it has studied: the company that is carrying out the project, identifying how the company works and studying what are the key issues around the practice cited (Crowdsourcing Logistics) in each project.

In connection with the analysis of literature and the study of actual projects, and after having a vision about these two aspects, it has been able to proceed to develop its own definition of Crowdsourcing Logistics, which has been defined as a service offered by specific members of society that are the Crowd and their basically function is to pick up and deliver packages. It means that they are urban messengers that are working in exchange for a

certain reward. Also it has been understood clearly what are the factors that involves this practice and its main players.

With respect to the model created around the practice of Crowdsourcing Logistics and simulations, it should be noted that these simulations have shown that the model despite its limitations (hypotheses and data set) is consistent. Therefore could be valid to calculate costs and emissions around this logistics practice. With regard to the simulations, on one hand they give meaning and coherence to the model and for the other hand, they have allowed both draw specific conclusions on the theme of emissions and costs, and all that related to Crowdsourcing Logistics. So, it has got to have a deeper and more detailed view about what is really that affects each of these perspectives in this innovative practice. And basically these two aspects are linked to the distance travelled and the transport used (considering that the scenario was the ideal).

It must be said that throughout the project and doubts have arisen problems in making decisions, but slowly and meditating various possibilities have been solving every aspect in order to reach the targets set.

Finally, it is important to say that the main objectives attached at the beginning of this project have been achieved and it has get to have more awareness about the problems, the alternatives and the consequences that involves the deliveries in B2C e-commerce. For all these reasons, it has been considered that have obtained positive results in the development of this project, as much for the final results as for the learned knowledge.

6. BIBLIOGRAPHY

6.1. REFERENCES

Aized, Tauseef, and Jagjit Singh Srai. 2014. “Hierarchical Modelling of Last Mile Logistic Distribution System.” International Journal of Advanced Manufacturing Technology 70(5-8): 1053–61.

Al-nawayseh, M. K., Alnabhan, M. M., Al-Debei, M. M., & Balachandran, W. (2013). An adaptive decision support system for last mile logistics in e-commerce: a study on online grocery shopping. International Journal of Decision Support System Technology (IJDSST), 5(1), 40-65.

Brabham, D. C.Brabham, D.C., 2008. Crowdsourcing as a Model for Problem Solving: An Introduction and Cases. Convergence: The International Journal of Research into New Media Technologies, 14(1), pp.75–90. 2008. “Crowdsourcing as a Model for Problem Solving: An Introduction and Cases.” Convergence: The International Journal of Research into New Media Technologies 14(1): 75–90.

Brabham, D. C. 2009. “Crowdsourcing the Public Participation Process for Planning Projects.” Planning Theory 8(3): 242–62.

Brown, J. R., & Guiffrida, A. L. (2014). Carbon emissions comparison of last mile delivery versus customer pickup. International Journal of Logistics Research and Applications, 17(6), 503-521.

Bruce, G.M. and Daly, L. (2010), “Innovative process in e-commerce fashion supply chains”, in Edwin Cheng, T.C. and Tsan-Ming Choi (Eds), Innovative Quick Response Programs in Logistics and Supply Chain Management, Springer Berlin, Heidelberg, pp. 227-241.

Brugnoli, G., Mangiaracina, R. and Perego, A. (2009), “The ecommerce customer journey: a model to assess and compare the user experience of

the ecommerce websites", Journal of Internet Banking and Commerce, Vol. 14 No. 3, pp. 1-11.

Durach, F. 2014. "International Journal of Physical Distribution & Logistics Management Article Information :"

Howe, Jeff. 2006. "The Rise of Crowdsourcing." Wired Magazine 14(06): 1–5. http://www.clickadvisor.com/downloads/Howe_The_Rise_of_Crowdsourcing.pdf.

Edwards, Julia B., Alan C. McKinnon, and Sharon L. Cullinane. 2010. "Comparative Analysis of the Carbon Footprints of Conventional and Online Retailing: A 'last Mile' Perspective." International Journal of Physical Distribution & Logistics Management 40(1/2): 103–23.

Gevaers, Roel, Thierry Vanelslander, and Eddy Van de Voorde. 2011. "Characteristics and Typology of Last-Mile Logistics from an Innovation Perspective in an Urban Context." City Distribution and Urban Freight Transport: Multiple Perspectives: 56–71.

Ghezzi, Antonio, Riccardo Mangiaracina, and Alessandro Perego. 2012. "Shaping the E-Commerce Logistics Strategy: A Decision Framework." International Journal of Engineering Business Management 4(1): 1–13.

Howe, Jeff. 2006. "The Rise of Crowdsourcing." Wired Magazine 14(06): 1–5. http://www.clickadvisor.com/downloads/Howe_The_Rise_of_Crowdsourcing.pdf.

———. 2008. "Bringing Essential Knowledge & Book Summaries to High Achievers C ROWDSOURCING Why the Power of the Crowd Is Driving the Future of Business." Achievement THE International INSTITUTE unedited e: 320.

Hübner, A., Kuhn, H., & Wollenburg, J. (2016). Last mile fulfilment and distribution in omni-channel grocery retailing: A strategic planning framework. International Journal of Retail & Distribution Management, 44(3), 228-247.

Kamarainen, V., & Punakivi, M. (2004). Unattended reception–a business opportunity?. *International Journal of Services Technology and Management*, *5*(2), 206-220.

Kazai, Gabriella. 2011. "In Search of Quality in Crowdsourcing for Search Engine Evaluation." SIGIR Forum 44: 165–76. http://portal.acm.org/citation.cfm?id=1924481.

Kull, T. J., Boyer, K., & Calantone, R. (2007). Last-mile supply chain efficiency: an analysis of learning curves in online ordering. *International Journal of Operations & Production Management*, *27*(4), 409-434.

Mangiaracina, R., Perego, A. and Campari, F. (2012), "Factors influencing B2c e-commerce diffusion", World Academy of Science, Engineering and Technology, Vol. 65, pp. 311-319.

Mangiaracina, R., Marchet, G., Perotti, S., & Tumino, A. (2015). A review of the environmental implications of B2C e-commerce: a logistics perspective. *International Journal of Physical Distribution & Logistics Management*, *45*(6), 565-591.

Meixell, Mary J., and Mario Norbis. 2008. "A Review of the Transportation Mode Choice and Carrier Selection Literature." The International Journal of Logistics Management 19(2): 183–211.

Moilanen, Katja, Timo Niemi, Mikko Kuru, and Turkka Näppilä. 2012. "A Proposal for a Visual XML Dataspace System." Journal of Information Science 32(X): 1–22.

Mulpuru, S. (2013), “The state of retailing online 2013: key metrics and initiatives”, available at: www.forrester.com/The+State+Of+Retailing+Online+2013+Key+Metrics+And+Initiatives/fulltext/-/E RES89902 (accessed October 30, 2013).

Onghena, E., (2008), Integrators: werkwijze, strategieën en toekomst, Universiteit Antwerpen, Antwerpen.

Park, E.J., Kim, E.Y., Funches, V.M. and Foxx, W. (2012), “Apparel product attributes, web browsing, and e-impulse buying on shopping websites”, Journal of Business Research, Vol. 65 No. 11, pp. 1583-1589.

Petrovic, O., Harnisch, M. J., & Puchleitner, T. (2014). Research on mobile communication systems in last-mile logistics to create an end-to-end information flow. *International Journal of Services and Operations Management*, *19*(2), 172-190.

Punakivi, M., YrjoÈlaÈ, H., & HolmstroÈm, J. (2001). Solving the last mile issue: reception box or delivery box?. International Journal of Physical Distribution & Logistics Management, 31(6), 427-439.

Punakivi, M., & Tanskanen, K. (2002). Increasing the cost efficiency of e-fulfilment using shared reception boxes. *International Journal of Retail & Distribution Management*, *30*(10), 498-507.

Royal Mail (2007), Home Shopper Tracker 2007, RAPID Marketing Services, London.

Slater, A. (2002). Specification for a dynamic vehicle routing and scheduling system. *International Journal of Transport Management*, *1*(1), 29-40.

Smithers, R. (2007), “Supermarket home delivery service promotes its green credentials”, The Guardian, 12 September, available at:

www.guardian.co.uk/environment/2007/sep/12/ plasticbags.supermarkets (accessed 6 December 2007)

So, H. W., Gunasekaran, A., & Chung, W. W. (2006). Last Mile fulfilment strategy for competitive advantage. *International Journal of Logistics Systems and Management*, *2*(4), 404-418.

Srivastava, Samir K. 2007. "Green Supply-Chain Management: A State-of-the-Art Literature Review." International Journal of Management Reviews 9(1): 53–80.

Vanelslander, T., Deketele, L., & Van Hove, D. (2013). Commonly used e-commerce supply chains for fast moving consumer goods: comparison and suggestions for improvement. *International Journal of Logistics Research and Applications*, *16*(3), 243-256.

Visser, J.G.S.N & T. Nemoto (2001), E-commerce and the Consequences for Freight Transport. Research report, Ministry of Economic Affairs.

Wei, Z. and Zhou, L. (2011), "Case study of online retailing fast fashion industry", International Journal of e-Education, e-Business, e-Management and e-Learning, Vol. 1 No. 3, pp. 195-200.

Weltevreden, J. W. (2008). B2c e-commerce logistics: the rise of collection-and-delivery points in The Netherlands. International Journal of Retail & Distribution Management, 36(8), 638-660.

Xu, M., Ferrand, B., & Roberts, M. (2008). The last mile of e-commerce-unattended delivery from the consumers and eTailers' perspectives. International Journal of Electronic Marketing and Retailing, 2(1), 20-38.

6.2. WEBS

· AMAZON FLEX:

- https://flex.amazon.com/
- http://www.manutencionyalmacenaje.com/es/notices/2016/01/amazon-flex-ultima-milla-reparto-de-paquetes-al-estilo-uber-38753.php#.VvHpZT-qzL8
- http://www.xternaliza.es/amazon-tiene-previsto-la-expansion-del-proyecto-flex/
- http://www.tuexperto.com/2015/09/30/amazon-pagara-a-los-usuarios-por-repartir-paquetes/
- http://www.logisticaytransporte.es/noticias.php/Amazon-afianza-su-nuevo-servicio-de-entregas-en-colaboraci%C3%B3n-con-conductores-aut%C3%B3nomos.-cl.--amazon-paqueter%C3%ADa/61399
- http://www.businessinsider.com/amazon-working-on-secretive-project-called-amazon-flex-2015-8
- http://www.geekwire.com/2015/amazon-set-to-launch-new-amazon-flex-package-pickup-service-in-seattle-area-with-prime-now/
- https://en.wikipedia.org/wiki/Amazon.com

· DELIV:

- https://www.deliv.co/
- https://www.crunchbase.com/organization/deliv#/entity
- http://www.cnet.com/news/speedy-delivery-startup-deliv-expands-to-nine-new-markets/
- https://en.wikipedia.org/wiki/Deliv
- http://www.allthefrugalladies.com/shopping/become-deliv-driver/

· DOORDASH:

- https://www.doordash.com/

· INSTACART:

- https://www.instacart.com
- http://www.thepennyhoarder.com/dont-mind-grocery-shopping-make-25-per-hour-delivering-food-with-instacart/

· MyWays:

- https://en.wikipedia.org/wiki/DHL_Express
- https://www.myways.com/
- http://www.dhl.com/en/press/releases/releases_2013/logistics/dhl_crowd_sources_deliveries_in_stockholm_with_myways.html#.VwZwJj_rzL8
- http://www.delivered.dhl.com/en/articles/2014/04/what-s-the-story-mr-oom.html

· POSTAMATES:

- https://postmates.com/
- https://en.wikipedia.org/wiki/Postmates

· RICKSHAW:

- https://gorickshaw.com/
- https://angel.co/rickshaw/activity

· SIDECAR DELIVERIES:

- https://www.side.cr/
- https://en.wikipedia.org/wiki/Sidecar_%28company%29
- https://www.theguardian.com/technology/2015/dec/30/uber-competitor-sidecar-shut-down
- https://www.side.cr/why-we-sold-to-gm/

· UberEATS:

- https://ubereats.com
- http://postandparcel.info/71869/news/ubereats-sets-to-expand/

· UberRUSH:

- http://www.logisticaytransporte.es/noticias.php/Uber-lanza-su-propia-empresa-de-paqueter%C3%ADa.-cl.--paqueteria/62627
- https://rush.uber.com/how-it-works

- https://www.uber.com
- https://en.wikipedia.org/wiki/Uber_%28company%29
- https://newsroom.uber.com/us-new-york/a-reliable-ride-for-your-deliveries/
- http://lyftubernewsletter.com/uber-rush/
- http://www.jobmonkey.com/shared-economy/on-demand-delivery/uber-rush/

· ZIMPMENTS:

- https://zipments.com/
- http://www.xconomy.com/new-york/2015/11/10/deliv-acquires-zipments-for-undisclosed-sum/
- https://angel.co/zipments/activity
  http://www.crowdsourcing.org/editorial/delivery-gets-personal-with-zipments/27808

ANNEXES

1. Results of the simulation

RESULTS SCENARIO AND CASES			
NAME OF CASE	TRANSPORT	COSTS	EMISSIONS
CASE 1-A	By CAR Petrol	7,93	1,13
	By CAR Diesel	7,36	1,04
	By MOTORBIKE	4,69	0,89
	By BICYCLE	5,40	0,00
	On FOOT	14,16	0,00
CASE 1-B	By CAR Petrol	4,46	0,58
	By CAR Diesel	4,17	0,53
	By MOTORBIKE	2,81	0,46
	By BICYCLE	3,17	0,00
	On FOOT	7,64	0,00
CASE 1-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 1-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 1-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 2-A	By CAR Petrol	13,98	1,13
	By CAR Diesel	13,41	1,04
	By MOTORBIKE	10,38	0,89
	By BICYCLE	11,45	0,00
	On FOOT	20,21	0,00
CASE 2-B	By CAR Petrol	14,12	1,15
	By CAR Diesel	13,54	1,06
	By MOTORBIKE	10,81	0,92
	By BICYCLE	11,54	0,00
	On FOOT	20,47	0,00
CASE 2-C	By CAR Petrol	9,89	0,48
	By CAR Diesel	9,65	0,44
	By MOTORBIKE	8,52	0,38

	By BICYCLE	9,41	0,00
	On FOOT	14,24	0,00
CASE 2-D	By CAR Petrol	9,46	0,41
	By CAR Diesel	9,26	0,38
	By MOTORBIKE	8,78	0,44
	By BICYCLE	9,46	0,00
	On FOOT	14,38	0,00
CASE 2-E	By CAR Petrol	9,46	0,41
	By CAR Diesel	9,25	0,38
	By MOTORBIKE	9,05	0,50
	By BICYCLE	9,83	0,00
	On FOOT	15,47	0,00
CASE 3-A	By CAR Petrol	20,03	1,13
	By CAR Diesel	19,46	1,04
	By MOTORBIKE	16,79	0,90
	By BICYCLE	17,50	0,00
	On FOOT	26,26	0,00
CASE 3-B	By CAR Petrol	20,17	1,15
	By CAR Diesel	19,59	1,06
	By MOTORBIKE	16,86	0,92
	By BICYCLE	17,59	0,00
	On FOOT	26,52	0,00
CASE 3-C	By CAR Petrol	15,94	0,48
	By CAR Diesel	15,70	0,44
	By MOTORBIKE	14,57	0,38
	By BICYCLE	15,46	0,00
	On FOOT	20,29	0,00
CASE 3-D	By CAR Petrol	15,51	0,41
	By CAR Diesel	15,31	0,38
	By MOTORBIKE	14,83	0,44
	By BICYCLE	15,51	0,00
	On FOOT	20,43	0,00
CASE 3-E	By CAR Petrol	15,51	0,41
	By CAR Diesel	15,30	0,38
	By MOTORBIKE	15,10	0,50
	By BICYCLE	15,88	0,00
	On FOOT	21,52	0,00
CASE 4-A	By CAR Petrol	26,08	1,13
	By CAR Diesel	25,51	1,40
	By MOTORBIKE	22,84	0,90
	By BICYCLE	23,55	0,00
	On FOOT	32,31	0,00
CASE 4-B	By CAR Petrol	26,22	1,15
	By CAR Diesel	25,64	1,06
	By MOTORBIKE	22,91	0,92

	By BICYCLE	23,64	0,00
	On FOOT	32,57	0,00
CASE 4-C	By CAR Petrol	21,99	0,48
	By CAR Diesel	21,75	0,44
	By MOTORBIKE	20,62	0,38
	By BICYCLE	21,51	0,00
	On FOOT	26,34	0,00
CASE 4-D	By CAR Petrol	21,56	0,41
	By CAR Diesel	21,36	0,38
	By MOTORBIKE	20,88	0,44
	By BICYCLE	21,56	0,00
	On FOOT	26,48	0,00
CASE 4-E	By CAR Petrol	21,56	0,41
	By CAR Diesel	21,35	0,38
	By MOTORBIKE	21,15	0,50
	By BICYCLE	21,55	0,00
	On FOOT	26,47	0,00
CASE 5-A	By CAR Petrol	32,13	1,13
	By CAR Diesel	31,56	1,04
	By MOTORBIKE	28,89	0,90
	By BICYCLE	29,60	0,00
	On FOOT	38,36	0,00
CASE 5-B	By CAR Petrol	32,27	1,15
	By CAR Diesel	31,69	1,06
	By MOTORBIKE	28,96	0,92
	By BICYCLE	29,69	0,00
	On FOOT	38,62	0,00
CASE 5-C	By CAR Petrol	28,04	0,48
	By CAR Diesel	27,80	0,44
	By MOTORBIKE	26,67	0,38
	By BICYCLE	27,56	0,00
	On FOOT	32,39	0,00
CASE 5-D	By CAR Petrol	27,61	0,41
	By CAR Diesel	27,41	0,38
	By MOTORBIKE	26,93	0,44
	By BICYCLE	27,61	0,00
	On FOOT	32,53	0,00
CASE 5-E	By CAR Petrol	27,61	0,41
	By CAR Diesel	27,40	0,38
	By MOTORBIKE	27,20	0,50
	By BICYCLE	27,60	0,00
	On FOOT	32,52	0,00
CASE 6-A	By CAR Petrol	7,90	1,13
	By CAR Diesel	7,34	1,04
	By MOTORBIKE	4,66	0,90

	By BICYCLE	5,37	0,00
	On FOOT	14,14	0,00
CASE 6-B	By CAR Petrol	4,43	0,58
	By CAR Diesel	4,15	0,53
	By MOTORBIKE	2,78	0,46
	By BICYCLE	3,14	0,00
	On FOOT	7,61	0,00
CASE 6-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 6-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 6-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 7-A	By CAR Petrol	7,93	1,13
	By CAR Diesel	7,36	1,04
	By MOTORBIKE	4,69	0,89
	By BICYCLE	5,40	0,00
	On FOOT	14,16	0,00
CASE 7-B	By CAR Petrol	4,43	0,58
	By CAR Diesel	4,15	0,53
	By MOTORBIKE	2,78	0,46
	By BICYCLE	3,14	0,00
	On FOOT	7,61	0,00
CASE 7-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 7-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 7-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44

	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 8-A	By CAR Petrol	13,95	1,13
	By CAR Diesel	13,39	1,04
	By MOTORBIKE	10,71	0,90
	By BICYCLE	11,42	0,00
	On FOOT	20,19	0,00
CASE 8-B	By CAR Petrol	14,09	1,15
	By CAR Diesel	13,52	1,06
	By MOTORBIKE	10,79	0,92
	By BICYCLE	11,51	0,00
	On FOOT	20,45	0,00
CASE 8-C	By CAR Petrol	9,87	0,48
	By CAR Diesel	9,63	0,44
	By MOTORBIKE	8,50	0,38
	By BICYCLE	9,38	0,00
	On FOOT	14,21	0,00
CASE 8-D	By CAR Petrol	9,44	0,41
	By CAR Diesel	9,23	0,38
	By MOTORBIKE	8,76	0,44
	By BICYCLE	9,43	0,00
	On FOOT	14,35	0,00
CASE 8-E	By CAR Petrol	21,56	0,41
	By CAR Diesel	21,35	0,38
	By MOTORBIKE	21,15	0,50
	By BICYCLE	21,93	0,00
	On FOOT	27,57	0,00
CASE 9-A	By CAR Petrol	19,98	1,13
	By CAR Diesel	19,41	1,04
	By MOTORBIKE	16,74	0,90
	By BICYCLE	17,45	0,00
	On FOOT	26,21	0,00
CASE 9-B	By CAR Petrol	20,12	1,15
	By CAR Diesel	19,54	1,06
	By MOTORBIKE	16,81	0,92
	By BICYCLE	17,54	0,00
	On FOOT	26,47	0,00
CASE 9-C	By CAR Petrol	15,89	0,48
	By CAR Diesel	15,65	0,44
	By MOTORBIKE	14,52	0,38
	By BICYCLE	15,41	0,00
	On FOOT	20,24	0,00
CASE 9-D	By CAR Petrol	15,46	0,41
	By CAR Diesel	15,26	0,38

	By MOTORBIKE	14,78	0,44
	By BICYCLE	15,46	0,00
	On FOOT	20,38	0,00
CASE 9-E	By CAR Petrol	15,46	0,41
	By CAR Diesel	15,25	0,38
	By MOTORBIKE	15,05	0,50
	By BICYCLE	15,83	0,00
	On FOOT	21,47	0,00
CASE 10-A	By CAR Petrol	26,00	1,13
	By CAR Diesel	25,44	1,04
	By MOTORBIKE	22,76	0,90
	By BICYCLE	23,47	0,00
	On FOOT	32,24	0,00
CASE 10-B	By CAR Petrol	26,14	1,15
	By CAR Diesel	25,57	1,06
	By MOTORBIKE	22,84	0,92
	By BICYCLE	23,56	0,00
	On FOOT	32,50	0,00
CASE 10-C	By CAR Petrol	21,92	0,48
	By CAR Diesel	21,68	0,44
	By MOTORBIKE	20,55	0,38
	By BICYCLE	21,43	0,00
	On FOOT	26,25	0,00
CASE 10-D	By CAR Petrol	21,49	0,41
	By CAR Diesel	21,28	0,38
	By MOTORBIKE	20,81	0,44
	By BICYCLE	21,49	0,00
	On FOOT	26,40	0,00
CASE 10-E	By CAR Petrol	21,48	0,41
	By CAR Diesel	21,28	0,38
	By MOTORBIKE	21,08	0,50
	By BICYCLE	21,85	0,00
	On FOOT	27,49	0,00
CASE 11-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,33	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,13	0,00
CASE 11-B	By CAR Petrol	4,43	0,58
	By CAR Diesel	4,14	0,53
	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,14	0,00
	On FOOT	7,60	0,00
CASE 11-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44

	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 11-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 11-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 12-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,33	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,13	0,00
CASE 12-B	By CAR Petrol	4,43	0,58
	By CAR Diesel	4,14	0,53
	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,14	0,00
	On FOOT	7,60	0,00
CASE 12-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 12-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 12-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 13-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,33	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,13	0,00
CASE 13-B	By CAR Petrol	4,43	0,58
	By CAR Diesel	4,14	0,53

	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,14	0,00
	On FOOT	7,60	0,00
CASE 13-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 13-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 13-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 14-A	By CAR Petrol	13,94	1,13
	By CAR Diesel	13,38	1,04
	By MOTORBIKE	10,70	0,90
	By BICYCLE	11,41	0,00
	On FOOT	20,18	0,00
CASE 14-B	By CAR Petrol	14,08	1,15
	By CAR Diesel	13,51	1,06
	By MOTORBIKE	10,78	0,92
	By BICYCLE	11,50	0,00
	On FOOT	20,44	0,00
CASE 14-C	By CAR Petrol	9,86	0,48
	By CAR Diesel	9,62	0,44
	By MOTORBIKE	8,49	0,38
	By BICYCLE	9,37	0,00
	On FOOT	14,20	0,00
CASE 14-D	By CAR Petrol	9,43	0,41
	By CAR Diesel	9,22	0,38
	By MOTORBIKE	8,75	0,44
	By BICYCLE	9,42	0,00
	On FOOT	14,35	0,00
CASE 14-E	By CAR Petrol	9,42	0,41
	By CAR Diesel	9,22	0,38
	By MOTORBIKE	9,02	0,50
	By BICYCLE	9,79	0,00
	On FOOT	15,43	0,00
CASE 15-A	By CAR Petrol	19,96	1,13
	By CAR Diesel	19,39	1,04

	By MOTORBIKE	16,72	0,90
	By BICYCLE	17,43	0,00
	On FOOT	26,19	0,00
CASE 15-B	By CAR Petrol	14,42	1,15
	By CAR Diesel	19,52	1,06
	By MOTORBIKE	16,80	0,92
	By BICYCLE	17,52	0,00
	On FOOT	14,42	0,00
CASE 15-C	By CAR Petrol	15,88	0,48
	By CAR Diesel	15,64	0,44
	By MOTORBIKE	14,51	0,38
	By BICYCLE	15,39	0,00
	On FOOT	20,22	0,00
CASE 15-D	By CAR Petrol	15,45	0,41
	By CAR Diesel	15,24	0,38
	By MOTORBIKE	14,77	0,44
	By BICYCLE	15,44	0,00
	On FOOT	20,36	0,00
CASE 15-E	By CAR Petrol	15,44	0,41
	By CAR Diesel	15,24	0,38
	By MOTORBIKE	15,04	0,50
	By BICYCLE	15,81	0,00
	On FOOT	21,45	0,00
CASE 16-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,32	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,12	0,00
CASE 16-B	By CAR Petrol	4,42	0,58
	By CAR Diesel	4,13	0,53
	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,13	0,00
	On FOOT	7,60	0,00
CASE 16-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 16-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 16-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38

	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 17-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,32	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,12	0,00
CASE 17-B	By CAR Petrol	4,42	0,58
	By CAR Diesel	4,13	0,53
	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,13	0,00
	On FOOT	7,60	0,00
CASE 17-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 17-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 17-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 18-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,32	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,12	0,00
CASE 18-B	By CAR Petrol	4,42	0,58
	By CAR Diesel	4,13	0,53
	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,13	0,00
	On FOOT	7,60	0,00
CASE 18-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 18-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38

	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 18-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 19-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,32	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,12	0,00
CASE 19-B	By CAR Petrol	4,42	0,58
	By CAR Diesel	4,13	0,53
	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,13	0,00
	On FOOT	7,60	0,00
CASE 19-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 19-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 19-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 20-A	By CAR Petrol	13,94	1,13
	By CAR Diesel	13,37	1,04
	By MOTORBIKE	10,70	0,90
	By BICYCLE	11,41	0,00
	On FOOT	20,17	0,00
CASE 20-B	By CAR Petrol	14,08	1,15
	By CAR Diesel	13,50	1,06
	By MOTORBIKE	10,78	0,92
	By BICYCLE	11,50	0,00
	On FOOT	20,44	0,00
CASE 20-C	By CAR Petrol	9,85	0,48
	By CAR Diesel	9,62	0,44

	By MOTORBIKE	8,49	0,38
	By BICYCLE	9,37	0,00
	On FOOT	14,20	0,00
CASE 20-D	By CAR Petrol	9,42	0,41
	By CAR Diesel	9,22	0,34
	By MOTORBIKE	8,75	0,44
	By BICYCLE	9,42	0,00
	On FOOT	14,34	0,00
CASE 20-E	By CAR Petrol	9,42	0,41
	By CAR Diesel	9,21	0,38
	By MOTORBIKE	9,02	0,50
	By BICYCLE	9,79	0,00
	On FOOT	15,43	0,00
CASE 21-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,32	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,12	0,00
CASE 21-B	By CAR Petrol	4,42	0,58
	By CAR Diesel	4,13	0,53
	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,13	0,00
	On FOOT	7,60	0,00
CASE 21-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 21-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 21-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 22-A	By CAR Petrol	7,89	1,13
	By CAR Diesel	7,32	1,04
	By MOTORBIKE	4,65	0,90
	By BICYCLE	5,36	0,00
	On FOOT	14,12	0,00
CASE 22-B	By CAR Petrol	4,42	0,58
	By CAR Diesel	4,13	0,53

	By MOTORBIKE	2,77	0,46
	By BICYCLE	3,13	0,00
	On FOOT	7,60	0,00
CASE 22-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 22-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 22-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 23-A	By CAR Petrol	7,93	1,13
	By CAR Diesel	7,36	1,04
	By MOTORBIKE	4,69	0,90
	By BICYCLE	5,40	0,00
	On FOOT	14,16	0,00
CASE 23-B	By CAR Petrol	8,07	1,15
	By CAR Diesel	7,49	1,06
	By MOTORBIKE	4,76	0,92
	By BICYCLE	5,49	0,00
	On FOOT	14,24	0,00
CASE 23-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 23-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 23-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 24-A	By CAR Petrol	7,93	1,13
	By CAR Diesel	7,36	1,04

	By MOTORBIKE	4,69	0,90
	By BICYCLE	5,40	0,00
	On FOOT	14,16	0,00
CASE 24-B	By CAR Petrol	8,07	1,15
	By CAR Diesel	7,49	1,06
	By MOTORBIKE	4,76	0,92
	By BICYCLE	5,49	0,00
	On FOOT	14,24	0,00
CASE 24-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 24-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 24-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00
CASE 25-A	By CAR Petrol	7,93	1,13
	By CAR Diesel	7,36	1,04
	By MOTORBIKE	4,69	0,90
	By BICYCLE	5,40	0,00
	On FOOT	14,16	0,00
CASE 25-B	By CAR Petrol	8,07	1,15
	By CAR Diesel	7,49	1,06
	By MOTORBIKE	4,76	0,92
	By BICYCLE	5,49	0,00
	On FOOT	14,24	0,00
CASE 25-C	By CAR Petrol	3,80	0,48
	By CAR Diesel	3,56	0,44
	By MOTORBIKE	2,43	0,38
	By BICYCLE	3,32	0,00
	On FOOT	8,15	0,00
CASE 25-D	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,17	0,38
	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,37	0,00
	On FOOT	8,29	0,00
CASE 25-E	By CAR Petrol	3,37	0,41
	By CAR Diesel	3,16	0,38

	By MOTORBIKE	2,69	0,44
	By BICYCLE	3,74	0,00
	On FOOT	9,38	0,00

· **Note:**

The total distance considered between the shop and the customers are:

- 1 customer: 9,72 km.

- 2 customers: 9,94 km.

- 3 customers:
  - On foot and by bike: 16,97 km.
  - By car and by motorbike: 12,70 km.

- 4 customers:
  - On foot and by bike: 17,33 km.
  - By Motorbike: 14,96 km.
  - By Car: 10,68 km.

- 4 customers:
  - On foot and by bike: 20,05 km.
  - By Motorbike: 17,307 km.
  - By Car: 10,65 km.

The distance considered between the member of the Crowd and the Shop 2 is: 1,37 km.