

UNIVERSIDADE FEDERAL DE SÃO CARLOS

*campus Sorocaba*

DEPARTAMENTO DE ENGENHARIA DE PRODUÇÃO

PROGRAMA DE PÓS GRADUAÇÃO EM ENGENHARIA DE PRODUÇÃO

DÉBORA GRASSETTI MARTINS DA COSTA

**LAST MILE DELIVERIES OF E-COMMERCE ORDERS: A CROSS ANALYSIS OF  
CONSUMERS' AND CARRIERS' PERCEPTIONS.**

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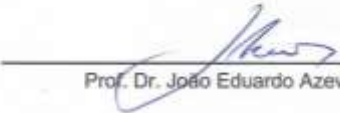
  
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## ABSTRACT

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The evolution of e-commerce has triggered a true revolution in the market. Due to that, the increase of deliveries changed the urban freight pattern flows and vehicles' traffic in the cities. These changes have consequences in technological, economic, environmental and social aspects. It is important to highlight that the adoption of good practices and strategies in e-commerce last mile distribution can influence positively the society in general. According to the literature, there is a high potential to use new technologies in the last mile to increase the customer experience, reduce costs, increase security, and support city environmental when delivering e-commerce purchases. Therefore, the aim of this study is to diagnose the e-commerce last mile delivery evaluating new technology solutions proposed by the literature and considering the perceptions from customers and e-commerce carriers. The used method was survey questionnaires applied to consumers and carriers in order to get different perceptions between them in São Paulo city. This region was chosen due to its relevance in the Brazilian demand and complexity in last mile delivery related to productivity, security and urban mobility. Customers and carriers consider more relevant performance and convenience aspects in relation to e-commerce delivery. However, carriers have a greater concern than customers with the points of infrastructure and environment. Demographic and risk data from São Paulo were also analysed and the results support the strategy definition to have pick up points being used to delivery e-commerce purchases in the São Paulo city, predominantly in the most distant areas of the city center.

Keywords: E-commerce, city logistics, urban logistics, last mile, pick up points, São Paulo.

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## 1. INTRODUCTION

This chapter initially contextualizes the subject of electronic commerce and provides an insight into the rationale behind last mile delivery of parcels, which is one of the last activities under the scope of supply chain management. The chapter also presents the general and specific objectives of this research, describing the studied problem and its relevance. Finally, the last section of the chapter details the structure of this document.

### 1.1. Contextualization

The technology evolution, specifically electronic commerce (e-commerce), has triggered a true revolution in business relations. The creation of e-commerce reduced the solid time-distance model, generating the possibility of "instant synchronization", as numerous operations began to be performed at the same time, regardless of the distance between the involved agents, replacing traditional sequential operations (SANTOS, 2006).

E-commerce is a bridge to fill the gap between the real and the virtual world and has changed the way of shopping; companies began to invest heavily in logistics and get loyal customers with on-time deliveries (GARCIA, 2016).

International e-commerce will grow by 26.6% between 2013 and 2020 (IPC, 2015), and in 2016, it had already reached a growth of 7.2% in parcel volumes (IPC, 2017).

The e-commerce has a major impact on the supply chain, affecting acquisitions, purchases, commercial partnerships and customer service, directly modifying trade relations (ALVES *et. al.*, 2013). However, the e-commerce emergence and expansion mainly affected logistics management in distribution, since it requires precision, speed and reduced response time, in order to guarantee customer satisfaction by delivering the product in good conditions and on time (CHAER, 2012).

For Comi and Nuzzolo (2016), the increase of deliveries changes the urban freight pattern flows and vehicles' traffic in the cities. Online shoppers' attitudes and preferences are key elements to be investigated, due to their

impact on last mile operations. In this context, it is also necessary to analyse the impacts brought by this new consumption trend as, in a broader perspective, the e-commerce growth increases the number of home deliveries.

The literature review reports some difficulties on last mile delivery regarding the security, urban mobility, sustainability and missed deliveries due to customer absences. According to Harrington, Srai and Kumar (2016) the last mile in distribution systems is complex and strategic for retailers, since it has major costs in the supply chain and impacts several stakeholders: customers, retailers, carriers and society.

The methodology was based on an exploratory research in order to understand the current scenario of e-commerce last mile deliveries and survey was chosen as a suitable technique to get the required information to be analyzed, based on questionnaires.

Survey research is a specific type of study that is based on the collection of data from a sample of elements drawn from a well-defined population through the use of a questionnaire (VISSER *et al.*, 2000).

Using survey was possible to incorporate multiple perspectives in an assessment. These perspectives were presented to specialists of the e-commerce transportation and also to customers in São Paulo city, in order to understand perceptions of both groups and compare their preferences in last mile delivery in the Brazilian e-commerce. This study also verifies if there are different demands between different regions of the city.

## **1.2. Problem Description**

E-commerce retail is a relatively a new phenomenon that has been changing the market. It is based on complex trade-offs between delivery responsiveness, variety and customer convenience (LIM AND SRAI, 2018).

The urban distribution of goods represents one of the last activities in the supply chain, so it is also known as "last mile" logistics (KIBA-JANIAK AND CHEBA, 2014).

Last mile is defined in the urban system as the final component in the

B2C delivery process. It has specific characteristics, including upstream logistics to the last transit point before the destination point of a delivery (customer delivery point). This step has critical value to all the involved stakeholders (HARRINGTON, SRAI AND KUMAR, 2016).

According to Harrington, Srai and Kumar (2016) the last mile in distribution systems is complex and strategic for retailers. Transportation costs in the e-commerce supply chain are considered the most critical elements to manage and equivalent to 75% of total supply chain costs.

In this context, Dutra (2004) describes the problem of last mile as issues related to cargo distribution in the end of the logistic chain. For Cárdenas, Beckers and Vanelslander (2017) the main last mile issues are: failed delivery issues, reverse logistics and environmental measures taken by policymakers.

Dutra et. al. (2006) attribute the problem of the last mile mainly to e-commerce, regarding the distribution of goods to final consumers, whose deliveries are at home.

For Ferrucci and Bock (2014), besides the benefits, rapid e-commerce growth has resulted in an increasing volume of parcel deliveries and returns. Due to that, it is also necessary to analyse the impacts created by this new consumption trend. According to Comi and Nuzzolo (2016), this new shopping trend can have an impact on freight traffic in urban areas since purchased products need to be delivered to the customer's houses through delivery routes which are not always optimized.

The increase of online sales resulted in a fragmentation of freight shipments. Logistics service providers are constantly challenged to deal with high competition. The last mile deliveries, widely accepted as the most expensive part of the trip, are a trade-off between internal costs, externalities and density of deliveries (CÁRDENAS, BECKERS AND VENELSLANDER, 2017).

As an example, failed deliveries in e-commerce purchases in United Kingdom represents 30% of small packages dispatched to customer homes, resulting in poor customer service and general logistics inefficiencies (HARRINGTON, SRAI AND KUMAR, 2016).

According to Harrington, Srai and Kumar (2016), there is no construct

that shows the relationship between the different criteria and interests of the different stakeholders in the last mile deliveries. So, the main research question is: “Which are the preferences of customers and transportation providers to decide the best delivery alternative in the last mile considering the complexity scenario of the e-commerce?”

The proposed methodology is applied to Brazilian context, more specifically in the São Paulo city, since this region represents the highest demand volume in Brazil and is impacted by several last mile difficulties, as will be detailed in the following sections.

Consumer preferences were also evaluated according specific characteristics of consumers and their distribution throughout the city in order to check if is there any some difference in demand based on profile and location.

### **1.3. Objectives**

Based on the problem description, this research aims to look the main preferences in the e-commerce last mile delivery and understand the acceptance of different types of deliveries in order to help to understand environment with different types of customer profiles. So, the main objective of this research is to cross check preferences and to compare the solutions for the delivery of e-commerce purchases in the last mile considering carriers and customer’s perspective.

The specific objectives consist in evaluate discrepancies between the perception of transportation providers and customers demand regarding last mile deliveries in the e-commerce. With this background this research intend to:

- Define the criteria identifying the main objectives in the background of delivering goods in the e-commerce last mile in São Paulo city, recognized as the main economic center in Brazil.
- Identify the preferences based on real demand and determine the best alternative for e-commerce last mile deliveries based on transportation and

customers perspective: delivery in a central point for customer pick up or delivery at customers address;

- Identify the possible discrepancies between perceptions of different customers segregated by region and which is offered in the market by carriers.

#### **1.4. Document Structure**

The following sections of this documents are organized as:

- Chapter 2 presents a literature review involving e-commerce and city logistics;
- Chapter 3 describes the methodology used to address the problem studied;
- Chapter 4 presents the results.
- Chapter 5 presents conclusions and futures researched proposal.

This document also presents the literature references used as the basis for this study and appendices.

## **2. LITERATURE REVIEW**

The concept of last mile delivery in the e-commerce represents a contemporary and multidisciplinary field of study involving traffic issues, consumer satisfaction and new services. In order to better understand the different approaches and their applications in a structured way, this chapter presents information found in literature and is subdivided in four sections: electronic commerce; logistics and city logistics and e-commerce last mile logistics. In this section is also presented a systematic review of scientific literature whose key words are the same of the present study in order to present a review summary of the area and research theme.

### **2.1. Electronic Commerce**

According to Walch (2009), electronic commerce is a cluster of technologies and processes in order to perform transactions using electronics. It is a concept, which includes process of buying and selling products, services or information. The usage of web services in business creates a completely new type of economy, the internet economy.

According to Kotler (2000), the term e-commerce encompasses a wide variety of types of electronic transactions, such as sending purchase orders to suppliers through EDI (electronic data interchange), banking transactions, as well as buying and selling goods and services in the internet, the latter modality to which this study is based, known as business to consumer (B2C) transactions.

The way to do business changed due to the internet and so e-commerce has a major function in the globalization process, changing relations and global market (WALCH, 2009).

E-commerce has developed rapidly around the world, based on the evolution of internet technologies, with the objective of complementing the sales process and eliminating intermediary stages in the supply chain. The e-commerce was developed to assist the globalization of the economy through partnership and business, lowering geographic boundaries, changing market

behaviour and creating business opportunities (KOTLER, 2000).

E-commerce is the exchange of business information, seeking business relationships and conducted by business transactions between different organizations and/or people. It involves buying and selling through the internet. There are several models of electronic commerce and it is classified according to the relationship between trade participants: companies, customers, employees and government (WALCH, 2009).

Table 1 summarizes the information regarding the different e-commerce models.

**Table 1** - E-commerce models. (Walch, 2009)

<b>Initials</b>	<b>Description</b>	<b>Process</b>
B2C	Business to Consumer	Sale of goods and services to end consumers.
B2E	Business to Employee	Web site that gives products or information to employees.
C2B	Consumer to Business	Consumer requests a product or service from the seller.
C2C	Consumer to Consumer	Customers sell to each other.
B2B	Business to Business	Companies sell to each other.
B2B2C	Business to Business to Consumer	Is realized using B2B model that supports the company's operations on the model of B2C.
C2B2C	Consumer to Business to Consumer	Connects consumers using on-line company as an intermediary.

Comparing to the traditional retail there are several advantages of e-commerce: sales staff is reduced, possibility to fulfill to globally market, instant communication, less investment is promotion and the possibility to adapt to customer needs (WALCH, 2009).

On the other hand, due to the complexity of the systems and the consolidation of the virtual stores, the main challenges of those companies are to meet and even exceed customer expectations through efficient logistics management in its operations: inventory planning, picking, physical

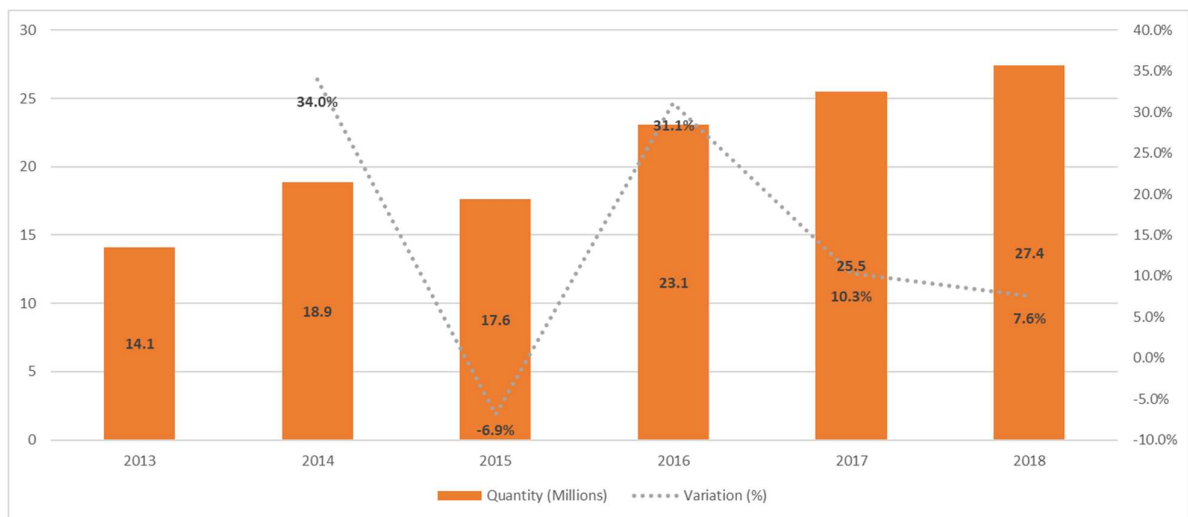


distribution and returns (ALVES *et al.*, 2013).

Internet has created a retail and consumer revolution due to the new and convenient channel for shopping: e-commerce. It grows year over year and covers a wide assortment of services and products (XING *et al.*, 2010).

E-commerce has increased in a two-digit rate and it impacts also in the number of customers (B2C) and delivery at home quantities (CÁRDENAS, BECKERS AND VANELSLANDER, 2017).

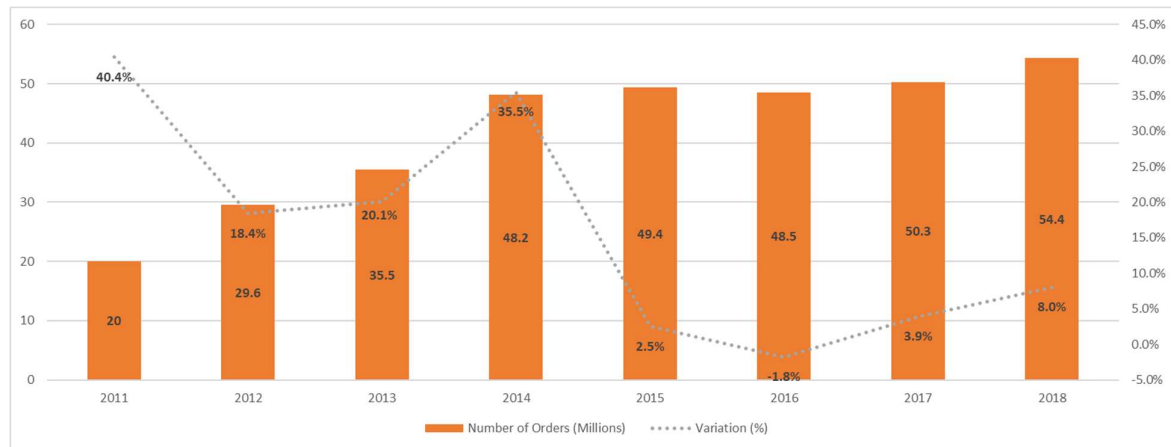
In Brazil, these numbers are also growing, according to researchers conducted by companies specialized in the e-commerce market. Figure 1 presents the absolute number of active customers in the country and the variation (%) year over year (YoY).



**Figure 1-** Evolution of e-consumers (E-bit, 2018)

It is important to highlight that except in 2015 when the country was going under an economic crisis, the amount of e-consumers grew year over year, achieving 27.4 MM active costumers in the year of 2018.

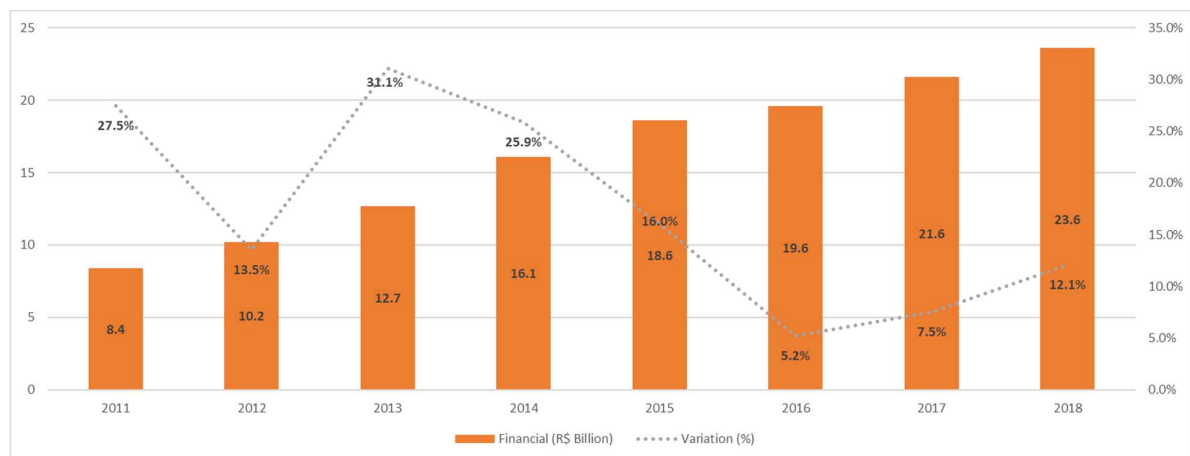
In the Figure 2, is possible to see that the absolute number of orders in Brazil is also increasing, achieving 54.4MM orders in 2018.



**Figure 2-** Number of Orders (E-bit, 2018)

The dashed line that represents the year over year (YoY) rate shows a resumption in orders growth since 2016 after impacts of economic crisis in the country.

Increase in the absolute values that also shown in Figure 3 achieving R\$23.6 Billion in 2018.



**Figure 3 -** Billing of Online sales (E-bit, 2018)

The dashed line that represents the year over year (YoY) rate shows also a growth recovery in the billing since 2016, after the economic crisis in Brazil.

However, to keep the market increasing it is necessary that e-retailers ensure appropriate customer service and a pleasant online shopping experience, including the order fulfilment process for their customers.

The responsibility of physical aspects of the fulfilment, which

previously was assigned to the customer, is now e-retailer responsibility (XING *et al.*, 2010), since online shopping enables consumers to stay at home just waiting their purchases to be delivered.

For many years, the retail activities have had their logistics operations oriented to distribution in stores, moving consolidated cargo. However, the e-commerce business growth required improvements in the traditional supply chain. The outbound activities must guarantee competitiveness in the online environment, as the consolidated cargo changed to individual items and small parcels for deliveries. Delivery times changed too: in traditional retail they were tied to deliveries to stores with weekly or monthly frequencies, while with the advent of e-commerce, deliveries are done within 24 to 48 hours (ALVES *et al.*, 2013). This has implications for the efficient management of distribution and fulfilment in the “last mile” (NICHOLLS AND WATSON, 2005).

## **2.2. Logistics and City Logistics**

According to the Council of Supply Chain Management Professionals (2018), logistics management is an integrated function that coordinates and optimizes all logistics activities, also integrating processes with other functions, including marketing, sales, finance and information technology. This definition comes from some specific activities such as logistic strategies applied within urban centers, theme studied by city logistics.

Taniguchi *et al.* (2001) conceptualize the term city logistics as the process of efficiency in logistics execution by private companies in urban areas, considering the traffic environment and energy consumption.

Urban areas are characterized by a high concentration of small commercial activities which generally result in a high number of vehicles movements, often uncoordinated and performed with less-than-truckload shipments (EHMKE, 2012). The problem generated by deliveries of goods in urban areas has been increasing awareness of citizens and organizations of the major problems generated by freight traffic (DUTRA, 2004).

According to Ehmke (2012), the concept of city logistics highlights the

need for efficient and environmentally-conscious urban transportation policies, that can improve the efficiency of transportation systems, as well as reduce energy consumption and vehicles emissions.

For Muñuzuri *et al.* (2005) to improve city logistics, several cities have decreed regulations regarding urban freight transport. These often limit certain types of vehicles at specific times of the day, depending on vehicle characteristics such as dimension and type of consumed energy.

Transportation causes disruption to city life, compromising the urban mobility. However, Kiba-Janiak and Cheba (2014) reinforce that the cargo urban distribution cannot be summarized only to the problems, since it is essential for the functioning of the city, contributing to economic and social development.

According to Crainic, Ricciardi and Storchi (2009) city logistics challenges governments, companies, carriers, and citizens in their relation to transportation, in order to introduce new operating models and requiring public-private understanding and innovative partnerships. These authors summarize the main objectives regarding city logistics as:

- Integration, partnership, coordination and consolidation are fundamental concepts in the design and operations of city logistics systems;
- Integration and partnership of various players/ decision makers, involved in urban freight transport: authorities, shippers, carriers, etc.;
- Planning coordination and decision-making processes regarding shippers and dispatchers;
- Consolidation of the different deliveries in the same vehicle between points of consolidation and final deliveries.

For Shao *et al.* (2019) the preliminary studies about e-commerce city logistics were concentrated mainly because it is one of the costliest and least efficient in the e-commerce economy. However is important also to explore how transportation demands in urban areas can be fulfilled efficiently while meets the constraints.

### 2.3. E-commerce last mile logistics

The urban distribution of goods represents one of the last activities in the supply chain, so it is also known as "last mile" logistics (ANTÚN, 2013).

The last mile is especially important in e-commerce as transportation is also a part of the purchase experience since customers not only concern about products, but how they will be delivered (SHAO *et al.*, 2019).

For Ferrucci and Bock (2014) rapid e-commerce growth has resulted in an increasing volume of parcel deliveries and returns. So, there are impacts created by this new consumption trend: freight traffic in urban areas.

In general the delivery process can be detailed in three main steps after the fulfilment process in the retailers' distribution center:

- The carrier pick up the packages, usually made within a pre-agreed window, orders are taken to a carrier's sort center where the pickup vehicles are unloaded and loaded onto a transfer trucks;
- With the arrival of the goods in the sort center closest to the delivery address, the transfer trucks are unloaded, the order are routed and loaded into urban cargo vehicles.
- In this final step, the last mile, urban vehicles perform the deliveries into customer's address (MENDES, 2017).

According to Van Duin *et al.* (2016), one of the major problems of home delivery is the high number of missed deliveries (25%), which results in a greater distance travelled, pollution emissions and additional costs. The main reason for deliver failure is the customer not being at home to receive the ordered goods ordered.

Another issue faced during the last mile deliveries is related to cargo theft. According to Casella (2011) stolen cargo is a serious problem globally, but in each region of the world has its own specific characteristics. In a context of weak economy, the risk of stolen cargo increases with people willing to steal goods and cash-strapped consumers become more willing to buy pilfered products, a risk for businesses that buy or sell goods in a vulnerable position. Cargo robbery can result in a financial loss for the retailer and for the buyer but will also disrupt the supply

chain.

In Brazil, cargo thefts generate significant losses for the whole supply chain, increasing the security costs, in which companies invest money to guarantee the purchases delivery, added to the losses of the stolen cargo. E-commerce suffers from this type of loss and occurs a migration of road robberies to urban areas. When theft occurs, the disruption begins: the consumer is harmed and, even if notified of the delay, receives the purchase late and has the sensation of a bad customer experience (FECOMERCIO, 2017).

E-commerce loses business due to the increase in cargo theft, so online stores restrict deliveries in high-risk areas or suggest pick up point for customers from these areas. This was the alternative that retailers found to mitigate cargo theft during the last mile delivery (CHIARA, 2019).

In summary, e-commerce last mile logistics demonstrates that it impacts sustainability factors: social, economic and environmental, as well as has a major impact related to security and mobility in the urban logistics.

#### **2.4. Literature Systematic Review**

Looking for the state-of-art in the e-commerce last mile topic, a systematic review was done based on the procedures created by Smart, Tranfield and Denyer (2003).

To conduct the systematic research some criteria were applied in order to collect the data, organize, classify and display into analysis. The selection considered papers available in the databases SCOPUS and Web of Science, given the relevant quality of the publications from the perspective of the academic community. The systematic review considered peer-reviewed papers which contains the terms: ("e-commerce" OR "comércio eletrônico" OR "electronic commerce") AND ("last mile" OR "home delivery" OR "entrega" OR "urban logistics" OR "logística urbana") in the paper title, keywords or abstract. Papers in Portuguese and English were considered and terms for the search were also considered in Portuguese and English.

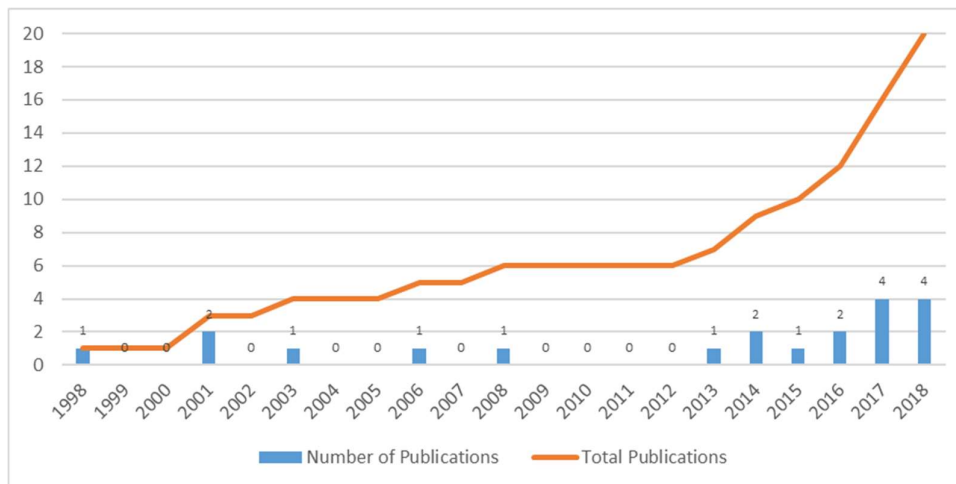
Papers without document object identifier (DOI) were excluded, in order to guarantee access and future consultations for interested parts, resulting

in the Scopus database 69 articles to be analysed and 48 in Web of Science database. The research filters were applied in all databases and 31 duplicated papers were excluded, resulting in a total of 86 full papers.

To reduce the scope and guarantee that authors are focusing in their study and research field, a second phase of elimination of papers identified and disconsidered papers that focused on areas other than last mile operations.

In this second phase after reading the abstracts, papers non related to e-commerce last mile operations, specific with just operational research models, environmental researches and specific financial models were not considered for a deep analysis. Papers with mixed content (specific theme + operations) were maintained in order to guarantee a minimum number of researches to be analysed in this systematic review. Applying these criteria, twenty papers from nineteen different sources satisfactorily fit and were considered for a systematic review on e-commerce last mile thematic.

There is an increase tendency in the number of publications in academic journals since 2015 as is shown in Figure 4. It is interesting to analyse how the timeline theme behave over the years and is related directly to the e-commerce revolution and growth, which could be split in four “ages”. This division between “ages” was developed by the author since there are four different approaches in the publications.



**Figure 4** - Evolution of the publication on last mile delivery (Developed by author)

In the “first age”, there is just a first publication on this thematic. Gould

(1998) predicted the transportation implications emerging after the on-line commerce deployment. The author affirmed that delivery activities and patterns would change in the same pace of electronic commerce development. Since that time, most of retail activities were in physical stores, it means that most goods were shipped to stores and people physically went to stores to purchase goods. Gould (1998) noted the demand of home-delivery services and the changes in the transportation network. However, the author attested it was difficult to forecast the impacts and the future structure since network and software were under construction, incipient during the research.

In the following years, a “second age” of publications rises from 2001 to 2008, when papers presented the home deliveries as success factors for e-commerce transactions. So, Gunasekaran and Chung (2006) described in their research that one of the biggest challenges in the e-commerce was the last mile. According to them, the companies should differentiate themselves combining profitability and a high service level, including the delivery services in their corporate strategy with project initiatives, adding value for the organizations.

In the “third age”, from 2013 to 2015, issues and challenges raised up as the main focus in the researches. Wang and Zhou (2015) presented that the rapid growth of online shopping impacts person-related aspects, household-related aspects, and regional-specific variables. According to these authors, these impacts are generated by the increase in the home delivery frequency, exposing a data limitation for the correcting routing process in urban areas.

Finally, in the “fourth age”, from 2016 to 2018, authors concentrated their efforts to propose solutions and alternatives for the last mile e-commerce challenges, with new tools and technologies to support it, as crowdshipping and pick up points. This is the era with the largest amount of published works, showing that solutions are being demanded by the market, given the problem has become evident. In this context, the researches look for specific application models in different regions. It is the case of Deutsch and Golany (2018) paper that proposes a parcel locker network as a solution to the logistics last mile problem.

The twenty selected papers were classified according to their method as shown in Table 2.



**Table 2** - Systematic Review: paper's methodology (Developed by author)

<b>Authors</b>	<b>Method</b>
Gould, (1998)	Literature Review
Punakivi and Saranen, (2001)	Simulation
Punakivi, Yrjölä and Holmström, (2001)	Simulation
Murphy, (2003)	Case study
So, Gunasekaran and Chung, (2006)	Literature Review
Xu, Ferrand and Roberts, (2008)	Survey
Xu and Hong, (2013).	Regression
Ducret, (2014)	Case study
Chen <i>et al.</i> , (2014)	Survey
Wang and Zhou, (2015)	Operational research
Wang <i>et al.</i> , (2016)	Survey
Ghajargar, Zenezini and Montanaro, (2016)	Survey
Oliveira <i>et al.</i> , (2017)	Case study
Cárdenas, Beckers and Vanelslander, (2017)	Survey
Cherrett <i>et al.</i> , (2017)	Survey
Kedia, Kusumastuti and Nicholson, (2017)	Survey
Allen <i>et al.</i> , (2017)	Case study
Castillo <i>et al.</i> , (2018)	Case study
Deutsch and Golany, (2018)	Operational research
Wang <i>et al.</i> , (2018)	Survey

As shown in Table 2, there is a wide variety of methods used in the analysed papers in this literature systematic research and a greater occurrence of case studies and survey case methods. Considering the relevance of last mile delivery for e-commerce and its analysis potential, there is more to be done in this thematic, with a greater depth on the subject.

As presented before regarding the year of publication, the papers differentiate themselves in different “ages”, in all of them some topics were highlighted in order to present the relevance of the theme, its implications for urban logistics and solutions, techniques and tools to help the last mile delivery of e-commerce parcels. Revealing an evolution in maturity in the analysis of the theme: one possible problem, what its impacts, how this could be treated

as a competitive differential and what can be done to do so.

In order to present solutions, some papers present proposals to solve the generic challenge of the increase of freight demand to attend home deliveries, exposed in all papers. Ghajargar, Zenezini and Montanaro (2016) in this context of increasing amount shipments and their frequency variation, expose new technologies and innovations to increase the efficiency of logistics service providers.

Table 3 presents some proposals extracted from the papers during the systematic review.

**Table 3** - Systematic review proposals, authors and publication year. (Developed by author)

<b>Proposal</b>	<b>Author(s) / Year of Publication</b>
Delivery Box	Punakivi, M., Yrjölä, H., Holmström, J. (2001)
Picking Up Service	Xu, J.J., Hong, L. (2013)
City Hub	Ducret, R. (2014)
Automated Pack Stations	Ghajargar, M., Zenezini, G., Montanaro, T. (2016)
Automated Delivery Stations	Oliveira, L.K.D., Morganti, E., Dablang, L., Oliveira, R.L.M.D. (2017)
Pick up points	Cardenas, I.D., Dewulf, W., Vanelslander, T., Smet, C., Beckers, J. (2017)
Consolidation of delivery	Cherrett, T., Dickinson, J., McLeod, F., Sit, J., Bailey, G., Whittle, G. (2017)
Delivery points	Kedia, A; Kusumastuti, D; Nicholson, A. (2017)
Crowdsourcing	Castillo, V.E., Bell, J.E., Rose, W.J., Rodrigues, A.M. (2018)

Note that Delivery Box, Picking up Service, Automated Pack Stations, Automated Delivery Stations, Pick up points, Consolidation of delivery and Delivery points are different names for the same proposal: consolidate the deliveries in specific locations, pick up points or automated pick up points.

Ghajargar, Zenezini and Montanaro (2016) summarize the solution as a network of location in which companies install boxes, in which parcels are retained until the customer is able to pick them up. These locations are in general public places and offering this service, there is a reduction of the time

spent for the daily routes of delivery trucks, since carriers do not have to deliver parcels in customer's home but aggregate them in delivery points. In addition of that, investment costs of installing and maintaining pick up points are offset by transportation savings.

According to Vakulenko, Hellström and Hjort (2018) is also important to evaluate customer value in relation to parcel lockers, since the customer has to go to the place to pick up their order. So, for the e-commerce customer the station should be close to their residence or workplace or located on their daily routes.

Ducret (2014) proposes a “city hub” as a solution for the e-commerce last mile challenges. This hub works as a virtual exchange point, working as a consolidation point. From there, delivery personnel sort and exchange parcels, and then go on rounds. Everything is done on foot and with a trolley.

Another proposal extracted from the papers was crowdsourcing. Castillo *et al.* (2018) suggest a quick way of performing deliveries with independent drivers using their own vehicles to provide logistics services. The idea is use driver's current schedules and include e-commerce parcels in this routing. According to Punel and Stathopoulos (2017) crowdshipping is a frontier in logistics systems designed to allow citizens to connect via online platforms and organize goods delivery along planned travel routes.

Summarization of author's proposals to minimize the impacts of the e-commerce last mile can be checked on Table 4.

**Table 4** -Proposals systematic review (Developed by author)

<b>Proposal</b>	<b>Author(s)</b>	<b>Year</b>
	Punakivi, M., Yrjölä, H., Holmström, J.	2001
	Xu, J.J., Hong, L.	2013
	Ghajargar, M., Zenezini, G., Montanaro, T.	2016
Pick up points / Lockers	Oliveira, L.K.D., Morganti, E., Dablanc, L., Oliveira, R.L.M.D.	2017
	Cardenas, I.D., Dewulf, W., Vanellander, T., Smet, C., Beckers, J.	2017
	Cherrett, T., Dickinson, J., McLeod, F., Sit, J., Bailey, G., Whittle, G.	2017
	Kedia, A; Kusumastuti, D; Nicholson, A	2017
City Hub	Ducret, R.	2014
Crowdsourcing	Castillo, V.E., Bell, J.E., Rose, W.J., Rodrigues, A.M.	2018

Using a systematic review on the literature regarding the theme, was noted that there is an increase in the publications. Papers suggest that there are several challenges at last mile distribution in urban areas, due to the increase of home deliveries for e-commerce purchases, proposals are being developed in order to enhance the urban last mile activities.

In all proposals the main objective is to reduce the transportation path, since it can help the main objective for urban mobility improvements generating benefits for the well-being in a society and the cost reduction for the carriers.

It is also important to highlight that for each of these innovation, there is a range of operational, business, legal and behavioural problems that need to be considered (PUNEL AND STATHOPOULOS, 2017). As an example, according to the literature review, one of the most frequent propositions is the potential to use pick up points / lockers to deliver e-commerce purchases, in order to consolidate the routes, reducing transportation courses. Pick up points

have potential to reduce last mile deliveries problems in a context of accelerated e-commerce growth. Some concerns as the customer perception regarding pick up points and where those are located were raised by specialists and demand further researches, since some studies are case studies and represent a particular region analysis.

So, using survey questionnaires it is expected to deep dive in the importance for carriers and customers regarding the application of these new technologies, to identify if they can meet their expectations, expanding the research horizon besides one unique stakeholder and a particular case study location.

### **3. METHODOLOGY**

In order to discuss the method and the proceedings used to achieve the objectives proposed in this research, this chapter presents the research characterization and related procedures.

#### **3.1. Research characterization**

This research has an exploratory character since aims to provide the researcher a greater familiarity with the topic of last mile delivery in e-commerce. The exploratory character is confirmed by the general and specific objectives that seek to understand the criteria for last mile deliveries in the e-commerce in customer and carriers' perspective and also considering new solutions and its impacts aspects person-related, household-related, and regional-specific variables, due to the increase in the home delivery frequency.

These objectives will only be achieved through a specific and deep study of the thematic, which justifies the characterization of the research as exploratory (VIEIRA, 2002).

Considering the application of this modeling in São Paulo city, Brazil, this research is also classified as a case study, since it investigates a "specific region" in depth. Yin (2005, p. 32) defines case study as "an investigation to preserve the holistic and significant features of real-life events."

Data was collected directly from the carrier's decision makers and e-commerce customers in the specific region based on a questionnaire developed based on the literature review in order to support the criteria selection and decisions.

#### **3.2. Research procedures**

In order to identify the preferences for the decisions of e-commerce last mile deliveries, it was important to define the relevant criteria for delivering alternatives considering qualitative and quantitative inputs from stakeholders and literature review regarding applicability, accessibility, security, costs and customer experience. During the literature review it was observed that four

great criteria were very reinforced: economic, social, environmental and infrastructure. In this manner, this four cluster were also consider as the main points of the present research.

In this dissertation, the data considered the Brazilian scenario and focused in São Paulo city due to its relevance in the Brazilian scenario.

Therefore, in this region is possible to reach directly retailers, logistics specialists, carriers and customers for discussions.

So, the research followed the steps shown in Table 5. The following sections will also follow the structure presented in the table.

**Table 5 - Research Steps (Developed by author)**

#	Step	Objective	Method
1	Problem Understanding	Alignment regarding the perceptions of decision-makers related to the last mile e-commerce deliveries	Interview with strategic decision makers – stakeholders related to the problem
2	Criteria and alternatives definition	Definition of the criteria for measurement of objectives and alternatives of delivery	Literature review and stakeholders interviews
3	São Paulo city mapping	Definition of city scoping considering geography and economic inputs	City hall database research
4	Questionnaires development	Creation of the survey questionnaires	Researches discussions and application of test group
5	Samples definition	Definition of the sample to questionnaires application	Researches discussions
6	Application of questionnaires	Collection of data	Distribution into samples group (carriers and customers)
7	Questionnaires discussion	Analysis of collected data	Tabulation of results and comparisons
8	Results and conclusions	Analysis of results	Researches discussions

### 3.3. Criteria and delivery alternatives definition

This section exposes how criteria and alternatives were defined based on interviews with e-commerce transportation experts and available literature review.

Based on the systematic review of literature the list of the recurring criteria and sub criteria was created. In general, authors concentrated their analysis on the concept of sustainability and its three pillars – economic, social and environmental - and also on the infrastructure of cities.

According to Allen *et al.* (2017) online retailers have been managing their operations in order to guarantee the sustainability in the delivery of parcels to customers. In addition to reducing costs, many of the new delivery technologies result in greater efficiency in delivery operations and they are associated to social and environmental impacts. Punakivi and Saranen (2001) highlight as one of the most significant obstacles for the growth of e-commerce the lack of a suitable logistical home delivery infrastructure in the cities.

These information was used for the questionnaires developing: the criteria were used as four different clusters in the questionnaires and analysis. The subcriteria extracted from the literature review and carriers' interviews are the subcriteria inside each cluster. Table 6 have the subdivision of the questionnaires.

**Table 6** - Criteria and Subcriteria (Developed by author)

<b>Criteria</b>	<b>Subcriteria</b>
1. Economic	1.1 Technology (CRAINIC <i>et. al.</i> , 2009)
	1.2 Cost (SLACK <i>et. al.</i> , 2009)
	1.3 Damage risk (SLACK <i>et. al.</i> , 2009)
2. Social	2.1 Job generation in the community (CASTILLO <i>et al.</i> , 2018)
	2.2 Security – Cargo theft (CASELLA, 2011)
	2.3 Scheduled delivery availability (CRAINIC <i>et. al.</i> , 2009)
	2.4 Timely delivery (SLACK <i>et. al.</i> , 2009)
	2.5 Fast delivery (SLACK <i>et. al.</i> , 2009)
	2.6 Ease of Returns (point listed by the interviewed carriers)
	2.7 Reliability on delivery (get what you bought correctly) (SLACK <i>et. al.</i> , 2009)



3. Environmental	3.1 Air Pollution (OLIVEIRA <i>et al.</i> , 2017)
	3.2 Traffic Jam (FERRUCCI AND BOCK, 2014)
	3.3 Traffic accidents (DISTEFANO <i>et al.</i> , 2019)
	3.4 Noise pollution (DUTRA, 2004)
	3.5 Visual pollution (DUTRA, 2004)
4. Infrastructure	4.1 Place to park and unload vehicle (CHERRETT <i>et al.</i> , 2017)
	4.2 Police Security (VIEIRA <i>et al.</i> , 2015)
	4.3 Street lighting (point listed by the interviewed carriers)
	4.4 Signaling for cargo vehicles (MUÑUZURI <i>et al.</i> , 2005)

Delivery types were also classified as alternatives during the assessment. Classic deliveries and new types were segregated between delivery to an address informed by the customer or pick up the goods up on a service provider site, as shown in Table 7.

**Table 7** – Delivery Alternatives (Developed by author)

Alternatives	Delivery Method
1. Delivery in customer address	1.1 Residential address delivery (Traditional delivery)
	1.2 Commercial address Delivery (Traditional delivery)
	1.3 City Hub + Last Mile walk/ bike delivery (New delivery solution)
	1.4 Crowdsourcing delivery (New delivery solution)
2. Pick up of the purchase	2.1 Pickup point delivery (New delivery solution)
	2.2 Automated pick up point (New delivery solution)

### 3.4. São Paulo city mapping

As a next step of this study, a deep understanding of São Paulo city was done in order to support data analysis of the research.

São Paulo is a Brazilian city, capital of the homonymous state and main financial, corporate and mercantile center of South America, being also the most populous city in Brazil. According to Instituto Brasileiro de Geografia e Estatística - IBGE (2019), the estimated population in 2019 was 12,252,023 in

last census research, done in 2010, the population was 11,253,503 and demographic density was 7,398.26 inhabitants per km<sup>2</sup>.

In 2017, the average monthly salary was 4.2 minimum wages, equivalent to 3,935.00 Brazilian Reais (BRL), being the thirtieth largest income of the country, in a total of 5,570 cities. The proportion of employed persons in relation to the total population was 45.8%. In the other hand, considering households with monthly incomes of up to half a minimum wage per person (BRL 468.50 / 2017), São Paulo has 31.6% of the population in these conditions, which placed it in the 4,372 position of 5,570 Brazilian cities. (IBGE, 2019).

This scenario of inequality can be seen in a different pattern between its regions. According to Nadalin and Iglioni (2017), regarding demographic density, there are lower numbers in central areas and high concentration in the suburbs. There is also an unequal spatial distribution of transport infrastructure and urban facilities, which are disproportionately concentrated in the center and scarce in the suburbs.

Due to its economical and urban relevance, the city was chosen to run the present research in e-commerce urban logistics, and this scenario of inequality in the city was also considered for analysis. For this research, was used an existing subdivision of the city's neighborhoods, called *Subprefeituras* in Portuguese or "Regional City Hall". This was created by the city hall based on common characteristics and proximity, generating 32 Regional City Halls, which are shown in Figure 5.



**Figure 5 - Regional City Halls Map (PREFEITURA MUNICIPAL DE SÃO PAULO, 2013)**

The demographic data details from 2010 census of each Regional City Hall can be seen in Appendix A.

Note that in 2010 there were just 31 City Halls Regions. Sapopemba region was emancipated when the Prefeitura Municipal de São Paulo (2013) did that justifying 300,000 inhabitants in the region with specific demand. Previously the region was attached to Vila Prudente City Hall Region. Since census data is considered in the research, Sapopemba region was reattached to Vila Prudente in further steps of the research for analysis purposes.

In the 2010 census these 31 sub regions, were also classified according to their human development index (HDI), as is shown in Table 8.

**Table 8** - HDI per City Hall Region (PREFEITURA MUNICIPAL DE SÃO PAULO, 2017)

<b>City Hall Region</b>	<b>HDI</b>
Pinheiros	0.942
Vila Mariana	0.938
Santo Amaro	0.909
Lapa	0.906
Sé	0.889
Mooca	0.869
Santana	0.869
Butantã	0.859
Ipiranga	0.824
Aricanduva	0.822
Jabaquara	0.816
Penha	0.804
Casa Verde	0.799
Vila Maria/Vila Guilherme	0.793
Pirituba	0.787
Vila Prudente	0.785
Campo Limpo	0.783
Ermelino Matarazzo	0.777
Jaçanã	0.768
Freguesia do Ó	0.762
Cidade Ademar	0.758
Itaquera	0.758
Capela do Socorro	0.75
São Miguel	0.736
São Mateus	0.732
Perus	0.731
Itaim Paulista	0.725
M'Boi Mirim	0.716
Guaianazes	0.713
Cidade Tiradentes	0.708
Parelheiros	0.68

The HDI is a general measure of the human development of countries and territories of different dimensions, calculated since 1990 for all countries of the world, according to the methodology created by United Nations Development Program - UNDP (PREFEITURA MUNICIPAL DE SÃO

PAULO, 2017).

The application of this methodology on the municipal scale is named Municipal Human Development Index, which is a measure composed of indicators of three dimensions of human development: longevity, education and income. These three dimensions have the same weight and the averages are geometric, and the ranges of human development are fixed, being:

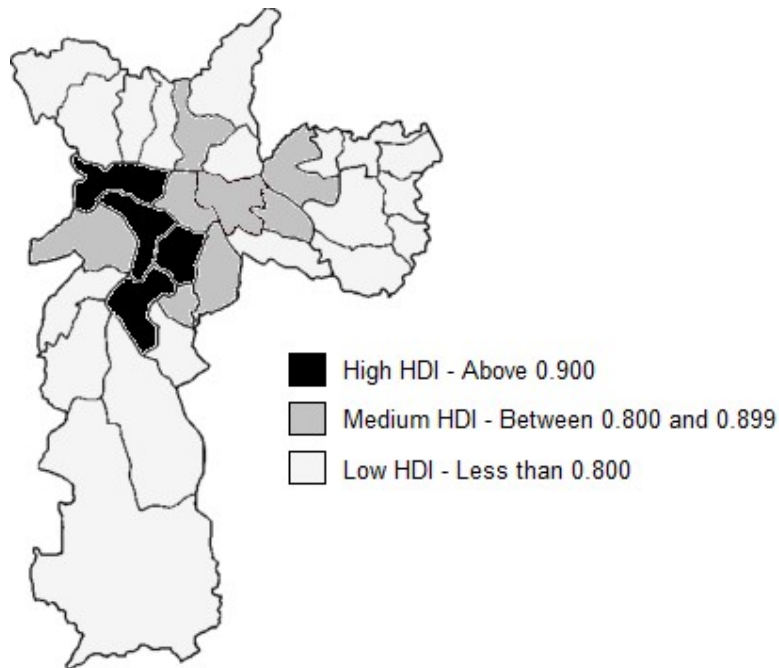
- Low human development, less than 0.550;
- Medium between 0.550 and 0.699;
- High, between 0.700 and 0.799;
- Very high, above of 0.800. (PREFEITURA MUNICIPAL DE

SÃO PAULO, 2017).

However as the HDI range in São Paulo city halls regions is between 0.68 (Parelheiros) and 0.942 (Pinheiros), a new HDI classification was proposed in order to better stratify the city in the analysis:

- Low human development, less than 0.800 – 19 city hall regions;
- Medium between 0.800 and 0.899 – 8 city hall regions;
- High, above 0.900 – 4 city hall regions.

The map distribution of São Paulo city per HDI based on this new classification is shown in Figure 6.



**Figure 6** - HDI per region in São Paulo city (Developed by author)

Another mapping that was done regarding São Paulo city was related to cargo theft.

Robbery history is available online in the Police files, in this documentation there is a sub classification of cargo theft per Police Station register, however without detailing which types of cargo are referring to last mile and especially the e-commerce segment. However, a greater concentration of thefts in the peripheral regions of the city was noted.

According to a research done in São Paulo state evaluating seventeen thousands police reports, cargo theft occurs in 86% of the cases in the peripheral regions of large cities and the most targeted products are those of lower value, since they are easier to resell (GALVÃO, 2019).

Correios, Brazilian Post and Telegraph Company, is a federal public company responsible for delivery system in Brazil. This national company also has provided a list of zip codes where they rate the region as risky, not delivering packages in the region or including extra time to do that due to its complexity.

The complete file has zip codes from states, however segregating the São Paulo city zip codes, was noted that São Paulo city currently has different

5,000 zip codes prefixes.

Note that the zip code format in Brazil is XXXXX-YYY and the main variance the prefix was analyzed in this study (XXXXX) in a consolidated manner.

From the 5,000 different prefixes zip codes, 83 (1.66%) has the most severe risk rating, in other words, no deliveries are made by the post office in the region and 734 (14.68%) has longer lead times due to the risk and complexity of access to the region.

The same analysis by City Halls Regions was performed and is shown on Table 9.

**Table 9** - Percentage of risky zip codes per city hall region (Developed by author)

City Hall Region	HDI	% Risky Zip codes	% Extra Time in Transit	% Delivery Restriction
Pinheiros	0.942	0.00%	0.00%	0.00%
Vila Mariana	0.938	0.00%	0.00%	0.00%
Santo Amaro	0.909	0.00%	0.00%	0.00%
Lapa	0.906	0.00%	0.00%	0.00%
Sé	0.889	0.00%	0.00%	0.00%
Mooca	0.869	0.00%	0.00%	0.00%
Santana	0.869	0.00%	0.00%	0.00%
Butantã	0.859	1.50%	1.50%	0.00%
Ipiranga	0.824	0.00%	0.00%	0.00%
Aricanduva	0.822	0.00%	0.00%	0.00%
Jabaquara	0.816	4.00%	4.00%	0.00%
Penha	0.804	0.00%	0.00%	0.00%
Casa Verde	0.799	20.67%	20.67%	0.00%
Vila Maria/Vila Guilherme	0.793	0.00%	0.00%	0.00%
Pirituba	0.787	0.00%	0.00%	0.00%
Vila Prudente	0.785	2.00%	2.00%	0.00%
Campo Limpo	0.783	38.00%	38.00%	0.00%
Ermelino Matarazzo	0.777	0.00%	0.00%	0.00%
Jaçanã	0.768	31.00%	31.00%	0.00%
Freguesia do Ó	0.762	63.00%	52.50%	10.50%
Cidade Ademar	0.758	69.00%	69.00%	0.00%
Itaquera	0.758	37.00%	8.00%	29.00%
Capela do Socorro	0.750	35.00%	35.00%	0.00%
São Miguel	0.736	57.00%	51.00%	6.00%
São Mateus	0.732	19.00%	13.00%	6.00%
Perus	0.731	38.00%	38.00%	0.00%
Itaim Paulista	0.725	75.00%	68.00%	7.00%
M'Boi Mirim	0.716	47.00%	47.00%	0.00%
Guaianazes	0.713	81.00%	71.00%	10.00%
Cidade Tiradentes	0.708	26.00%	22.00%	4.00%
Parelheiros	0.680	67.00%	67.00%	0.00%
<b>Total</b>	<b>NA</b>	<b>16.34%</b>	<b>14.68%</b>	<b>1.66%</b>

In Table 9, it is possible to verify that none of City Hall Regions classified with a high HDI have any zip code classified as risky by Correios. For Medium HDI regions just 2 of 8 regions has any zip code as risky, however in the low HDI regions, 16 from 19 (84.21%) have zip codes classified as risky. The table shows that the occurrence of risk areas is directly linked to the development of the region: less developed regions have higher delivery hazard



rates.

Guaianazes, as an example, has the third lowest HDI from São Paulo (0.713) and has the higher quantity of risky zip codes, 81% of its total and has also the higher ratio of extra time in transit (71%). Itaquera has the eleventh worst HDI (0.758) in the city and has the higher ratio where no deliveries are made in a zip code range, 29% of the total.

The Figure 7 shows the percentage of zip codes classified as risk area plotted on the city map of São Paulo per City Hall region.

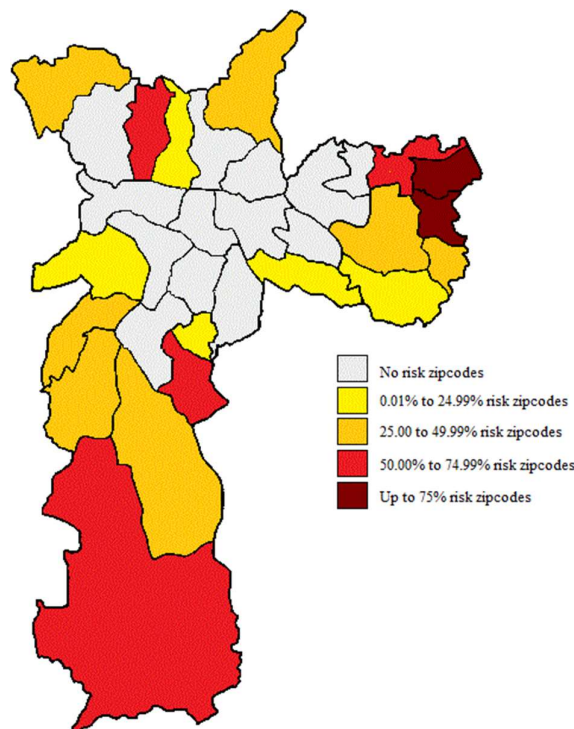


Figure 7 - São Paulo city map per risk zip codes percentage (Developed by author)

The consolidated zip code risk information per the HDI region can be seen in Table 10.

Table 10 - Zip code risk versus city hall regions per HDI. (Developed by author)

City Hall Region	% Risky Zip codes	% Extra Time in Transit	% Delivery Restriction
Low HDI	36.82%	33.05%	3.77%
Medium HDI	0.41%	0.41%	0.00%
High HDI	0.00%	0.00%	0.00%

This analysis was also validated at the stage of interviews with e-commerce transportation specialists who reported that Correios data is used even in the risk management of their carriers.

However, it is important to note that Correios makes e-commerce deliveries while it delivers other types of packages.

### **3.5. Samples definition**

As a next step of this study, the sample criteria was discussed. It was decided to segregate e-commerce transportation professional and e-commerce customers from São Paulo city.

The questionnaires were distributed and answered during the period between December 15<sup>th</sup>, 2019 and January 12<sup>th</sup>, 2020.

In this period, a total of 215 consumer questionnaires and 42 carrier's employees were answered. However, were used in the study effectively the answers of 189 consumer questionnaires and 36 carrier's employees. Consumer questionnaires that inappropriately answered the neighborhood or neighborhood outside the survey boundaries were disregarded (e.g. "Yes", "São Paulo", "North Zone", etc...). The same was considered for carrier's questionnaire, those ones with number of e-commerce deliveries less than one thousand in a year were also disregarded in order to guarantee the relevance of the answers for the research.

According to Barbetta (2002), using a sample turns the research faster and simpler and also able to bring important results. So, the sample error was calculated considering the total of customer's questionnaires.

Since the São Paulo e-commerce consumers' population is too big there is no need to consider the exact size of the population. In this case, the calculation of the sample is the result of:

$$n = \frac{1}{Eo^2} \quad (\text{Equation 1})$$

Where:

- n is sample size;
- Eo is the tolerable sampling error.

Considering  $n = 189$ , the result of Equation 1 is  $Eo = 0.073$ . So the error of the sample in this research is  $\pm 7.3\%$ .

For carrier's questionnaire, at least one representative from each company that transports e-commerce goods answered the questionnaire, so the sample is 100% relevant in the e-commerce transportation segment in São Paulo city.

There are two main techniques for determining the preferences of individuals: stated preference and revealed preference. The stated preference methodology deals essentially with hypothetical situations or situations where preferences or choices cannot be directly observed or measured. The revealed preference approach, on the other hand, is based on data obtained by direct observations or through questioning about real situations (DISTEFANO *et al.*, 2019). The research seeks to understand the perception of new delivery methods, so it is characterized as stated preference.

### 3.6. Data Analysis

The questionnaire answers were analyzed by clusters (economic, social, environmental and infrastructure) as mentioned in the previous sections and also in two different views: consolidated (all São Paulo city) and then its city hall regions divided by HDI.

In all scatter plots presented consumer perception data are on x-axis and carrier perception on y-axis. So, the criteria represented by points more to the right are considered more important for customers and as higher are considered more important for carriers' decisions.

## 4. RESULTS

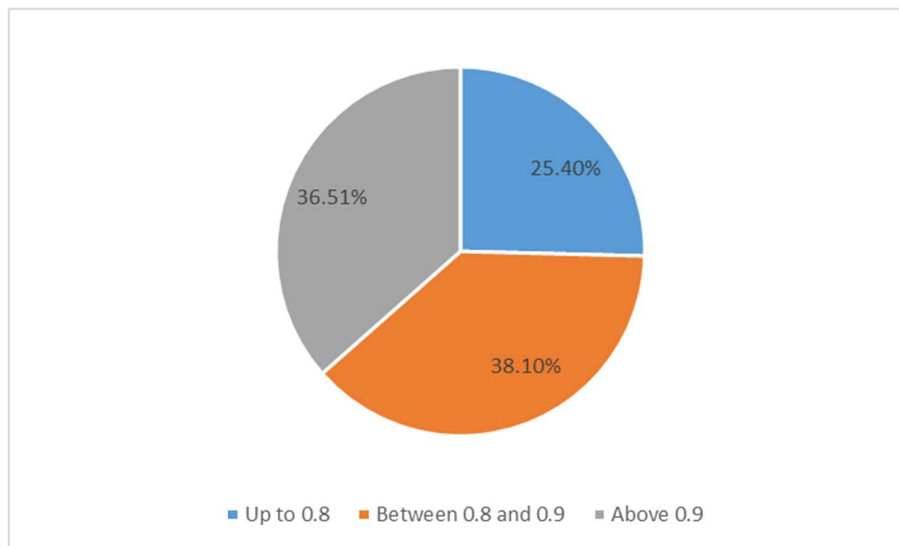
### 4.1 Sample Characterization

In this section it is presented the characterization of the sample separated by customers and e-commerce carriers' employees.

#### 4.1.1 Customer's characterization

In the analysis presented in this section, consumer responses were broken down into three large groups - per neighborhood HDI: low, medium and high.

Considering the 189 valid answers, 48 of it were from people in low HDI city hall region (25.40%), 72 from medium HDI region (38.10%) and 69 from high HDI (35.51). The distribution of the sample can be check on Figure 8.



**Figure 8** - Sample per HDI City Hall Region (Developed by author)

Regarding the age of e-commerce users in São Paulo city, in all HDI classifications are concentrated between 25 and 34 years old. In low HDI regions this range represents 50.0% of the total, for medium HDI 35.5% of the total and in high HDI 55.0% of the total of consumers. The complete

stratification by age group can be seen in the Figure 9.

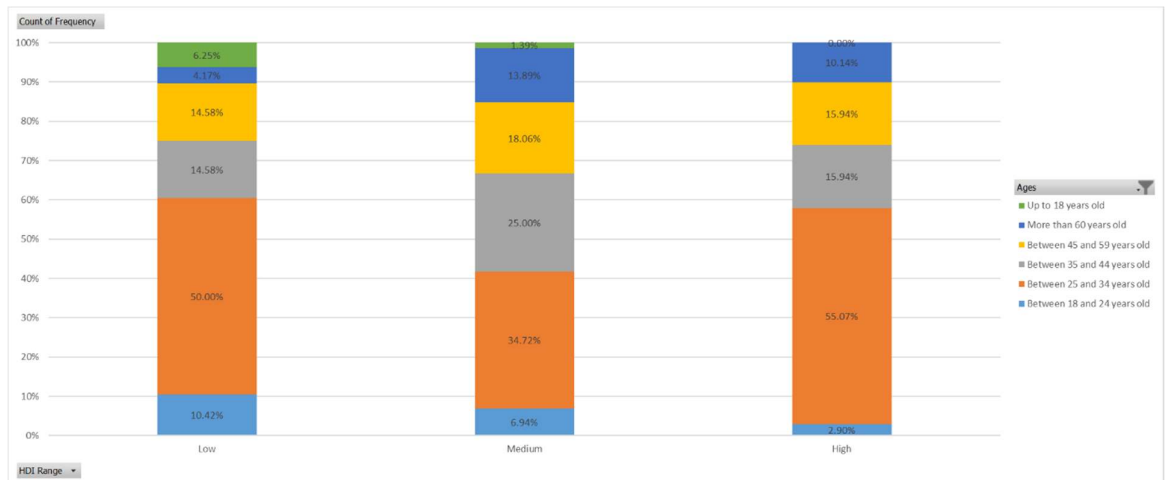


Figure 9 - Age of e-commerce users (Developed by author)

On average frequency of purchases there is variation among the different regions classified by HDI. In the low stratification most people (33.3%) do from 5 to 8 purchases in a year. However, in the middle and upper groups, most people make more than 12 purchases in a year, equivalent to 34.7% and 52.2% respectively. The complete stratification by frequency can be seen in the Figure 10.

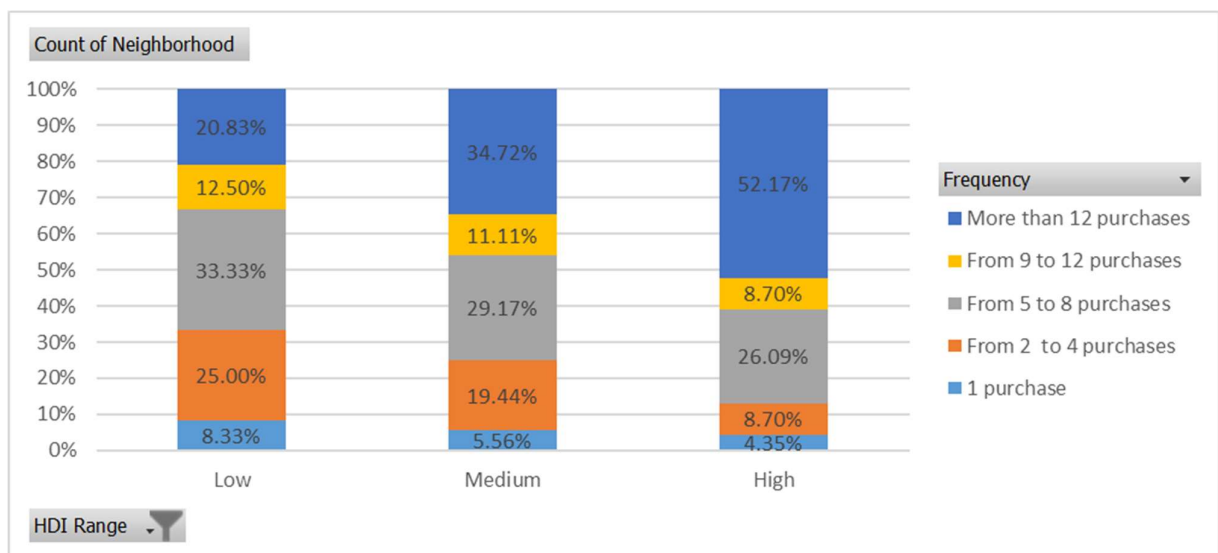


Figure 10 - E-commerce shopping frequency in a year (Developed by author)

In addition, the questionnaire got information regarding the time of use of e-commerce as a purchasing platform for these customers, as is shown on Figure 11.

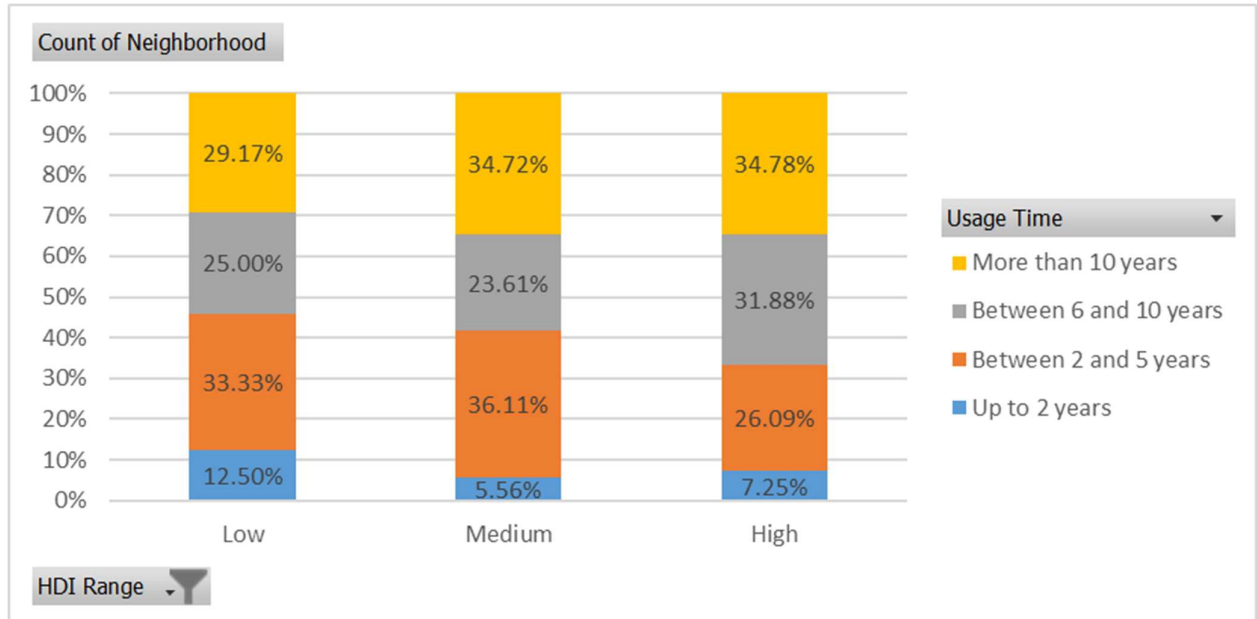


Figure 11 - Shopping time using e-commerce (Developed by author)

In Figure 11, it is possible to check that in low and medium HDI city hall regions most people, 33.33% and 36.11% respectively, use e-commerce between 2 and 5 years. In the other hand, most people from high HDI group (34.78%) are more experienced in e-commerce using the platform for more than 10 years. It is also the group with higher participation between 6 and 10 years (31.88%).

However, it is important to highlight that the distributions are quite similar to São Paulo city as a whole, regardless of the HDI group, as is shown in Table 11.

Table 11 - Percentage of e-commerce usage per City Hall region group (Developed by author)

HDI Group	Up to 2 years	Between 2 and 5 years	Between 6 and 10 years	More than 10 years
Low	12.50%	33.33%	25.00%	29.17%
Medium	5.56%	36.11%	23.61%	34.72%
High	7.25%	26.09%	31.88%	34.78%
São Paulo city	7.94%	31.75%	26.98%	33.33%

In the questionnaire it was also evaluated the type of address that customers request the delivery, which data is shown on Figure 12.

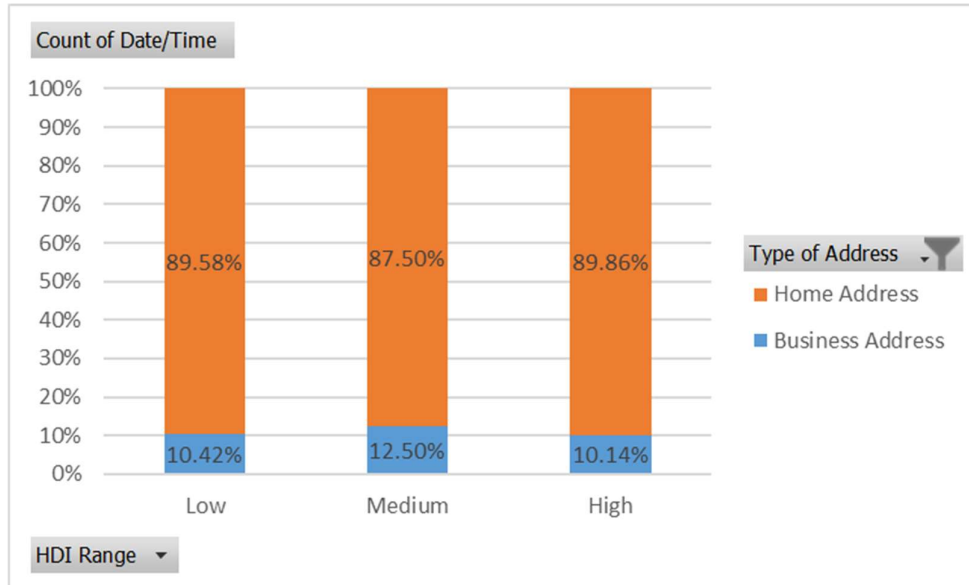


Figure 12 - Type of address delivery (Developed by author)

In all groups, home addresses were preferred comparing to business addresses, with 89.58% of preference in the low HDI City Hall region, 87.50% in the medium and 89.86% in the high HDI region.

#### 4.1.2 Carrier's employee's characterization

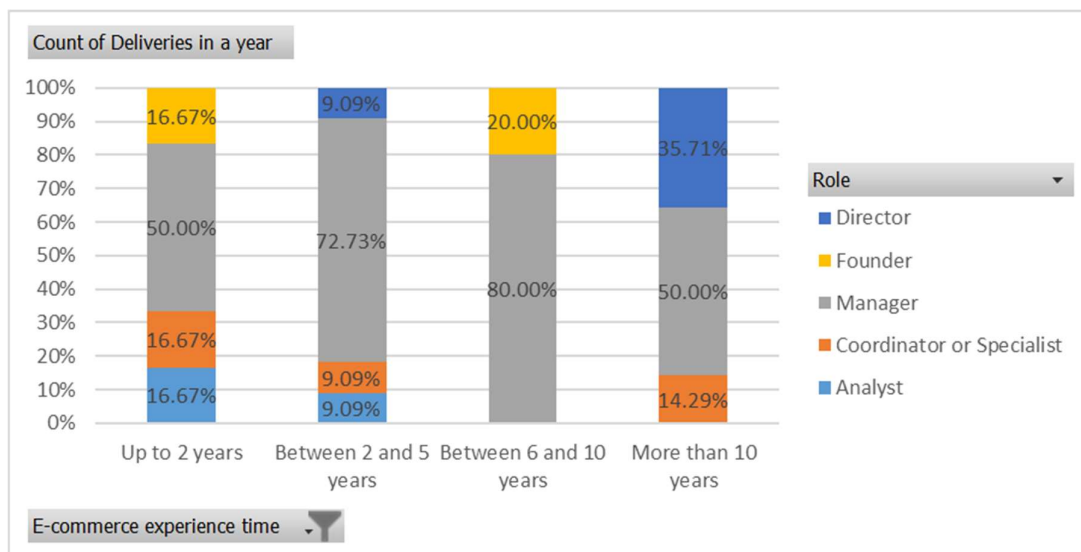
As mentioned in the previous section, employees from carriers operating in the e-commerce segment in the city of São Paulo received the questionnaires to be filled out.

Companies' names and revenues are not disclosed in this research since they do not interfere in the analysis of results and guaranteed the participation of all companies given the reliability of information that many of them work with e-commerce shippers.

The questionnaires were distributed to decision makers in last mile delivery strategies for e-commerce. Carrier's answers were consolidated, since in the preliminary interviews, they informed that there is no differentiation in

the delivery strategy by the city hall region.

These people were also classified according to their position and experience time specifically in the e-commerce segment, as is shown in Figure 13.



**Figure 13** - E-commerce experience time per job position (Developed by author)

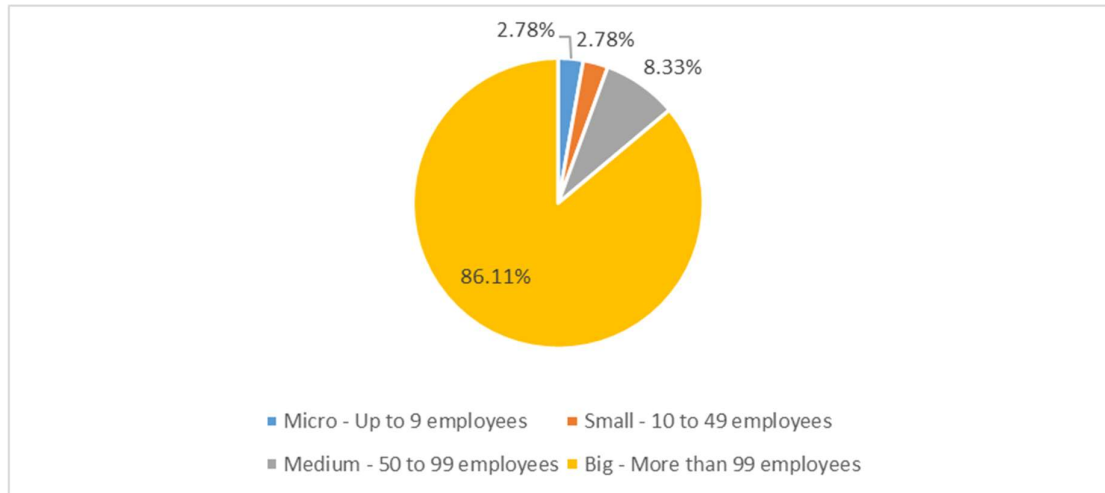
In a consolidated manner, 61.1% of the sample is composed by managers (22), 16.7% by directors (6), 11.1% by coordinators or specialists, 5.6% by founders and 5.6% by analysts. According to the time of experience in e-commerce, 16.67% of interviewed have up to 2 years (6), 30.56% have between 2 and 5 years (11), 13.89% between 6 and 10 years (5) and most respondents (38.89%) more than 10 years of experience in the e-commerce segment (14).

In order to classify their companies in the transportation market, questions about staffing size and annual e-commerce deliveries quantity were asked, following the classification of “Serviço Brasileiro de Apoio às Micro e Pequenas Empresas” - SEBRAE (2013) regarding employees quantity for service companies.

It was observed that 86.11% were classified as big companies in relation to the number of employees, having more 99 employees, thus revealing a trend in this e-commerce segment where retailers choose to work with major carriers. Micro to medium respondents were 13.89%. The



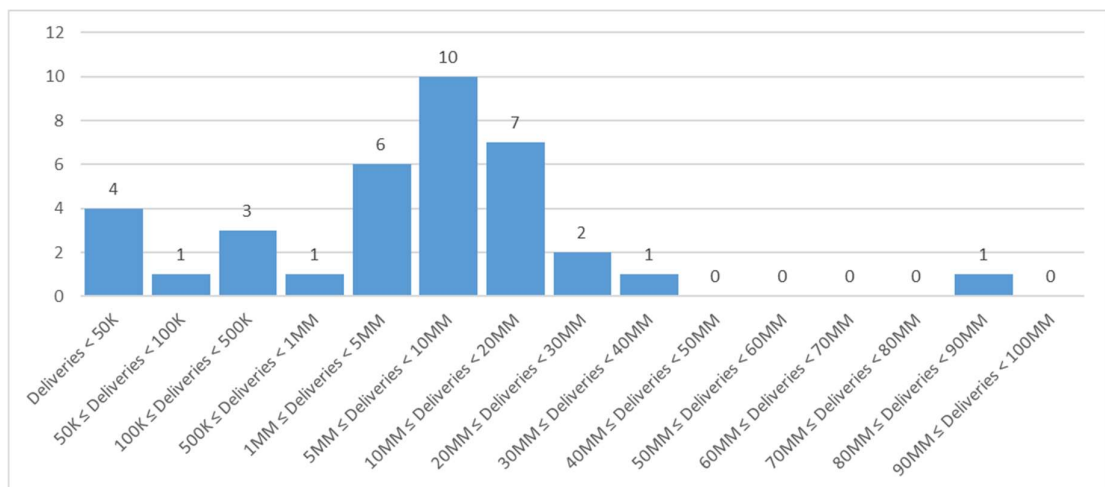
distribution of company sizes in research can be shown in Figure 14.



**Figure 14 - Company Size** (Developed by author)

In addition it was evaluated the volume of deliveries made by these companies in 2019, exclusively related to the e-commerce last mile delivery. These values ranged from 3,000 to 86,000,000 deliveries in a year. It is important to highlight that the values are relative to all year of 2019 and not exclusively regarding São Paulo city, some of these players have strong national coverage and performance.

These volumes are in package units and are displayed in the Figure 15.



**Figure 15 - Total e-commerce deliveries** (Developed by author)

The average of deliveries by these companies was  $9.7\text{MM} \pm 15.1\text{MM}$  packages delivered in a year. These numbers were also related to the size of the company, as shown in Table 12.

**Table 12** - Average of deliveries in a year per Company size (Developed by author)

<b>Company Size</b>	<b>Average of Deliveries in a year</b>
Micro - Up to 9 employees	3,000.00
Small - 10 to 49 employees	500,000.00
Medium - 50 to 99 employees	500,000.00
Big - More than 99 employees	11,152,372.90

Larger companies have higher average deliveries as well. Micro to medium companies have a number of e-commerce deliveries in the thousand order, while large companies in the order of millions.

## **4.2 Perceptions of consumers and carriers regarding last mile delivery**

The customer and carrier questionnaires (APPENDIX B) were developed using the criteria explained in the section 3.3. For each question in the customer questionnaire – demand - there was an equivalent question for carriers – offer - in order to evaluate possible misalignments.

In addition, customer responses were analyzed according to the HDI of each respondent in order to assess possible differences between the demands of these publics from different regions of the São Paulo city.

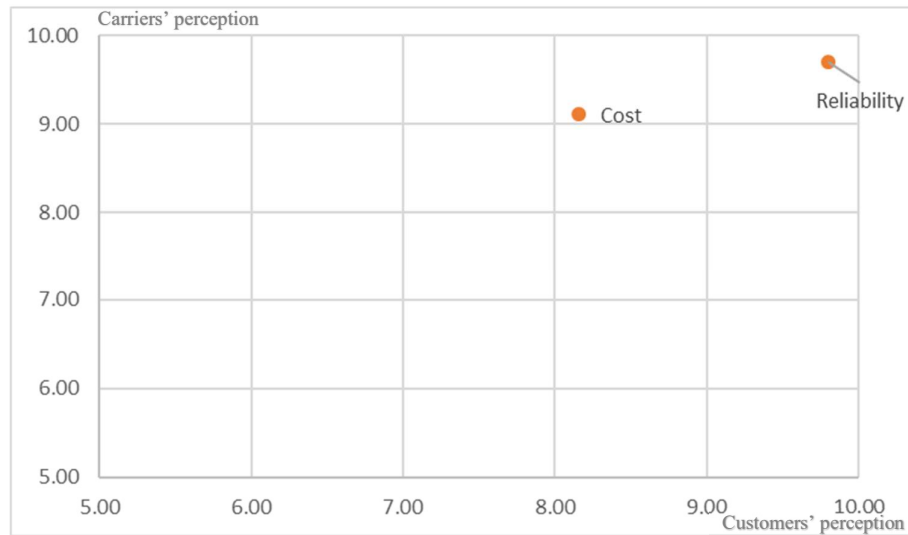
### **4.2.1 Economic Cluster Criteria**

In this section the general perceptions of the economic criteria were analyzed.

The economic cluster addressed the questions regarding the importance of freight cost and delivery reliability in order to avoid damages during the last mile.

In the Figure 16 is shown the general perception of all customers in São

Paulo city.



**Figure 16** - Economic Criteria: São Paulo city (Developed by author)

The cost criteria has greater importance to carriers ( $9.11 \pm 1.17$ ) than to customers ( $8.16 \pm 2.41$ ), the reliability of delivery, that ensures customers receive their items without damage, is a little more important to customers ( $9.80 \pm 0.92$ ) than to carriers ( $9.69 \pm 0.75$ ).

The economic criteria data is presented in Table 13.

**Table 13** - Economic Criteria Data (Developed by author)

	<b>Cost</b>	<b>Reliability</b>
São Paulo city Average	8.16	9.80
<i>São Paulo city Standard Deviation</i>	<i>2.41</i>	<i>0.92</i>
Low HDI City Hall Region Average	7.92	9.56
<i>Low HDI City Hall Region Standard Deviation</i>	<i>2.57</i>	<i>1.64</i>
Medium HDI City Hall Region Average	8.50	9.89
<i>Medium HDI City Hall Region Standard Deviation</i>	<i>2.19</i>	<i>0.46</i>
High HDI City Hall Region Average	7.97	9.87
<i>High HDI City Hall Region Standard Deviation</i>	<i>2.50</i>	<i>0.45</i>
Carrier Average	9.11	9.69
<i>Carrier Standard Deviation</i>	<i>1.17</i>	<i>0.75</i>

Customers from medium HDI City Hall Region give the most weight to economic criteria (cost and reliability) comparing to low and high HDI regions.

In both criteria, the least importance from the customer point of view is also given by the group of consumers residing in the low HDI city hall region, however, the numbers are generally close and high, revealing general importance of economic cluster.

In addition, the importance given by e-commerce carriers is very close, showing that there is no discrepancy in these criteria of what carriers are trying to offer and what the consumers expect.

#### 4.2.2 Social Cluster Criteria

In this section the general perceptions of the social criteria were analyzed.

The social cluster addressed the questions regarding the importance of local job generation and customer's perceptions regarding cargo theft risk, scheduled delivery availability, timely and fast delivery and easiness for returns.

In the Figure 17 is shown the general perception of all customers in São Paulo city versus carriers' perception.

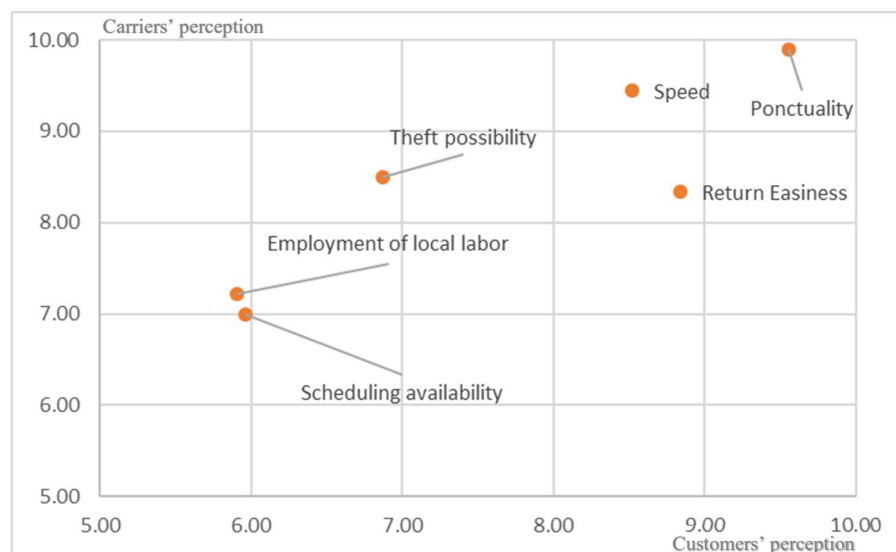


Figure 17- Social Criteria: São Paulo city (Developed by author)

The importance of punctuality is the higher even for customers ( $9.56 \pm$

1.05) as for carriers ( $9.89 \pm 0.40$ ). It is important to emphasize that the importance of carriers is even slightly higher.

From the customer's point of view, it is more important to receive on time (punctuality – 9.56) than the speed of delivery (8.52).

It is interesting to note that service option of scheduled delivery have more importance to carriers than even for customers as also the concern with cargo theft, where carrier (8.50) cares more than the customer (6.87). Regarding this criterion it is interesting to highlight that the burden of theft is carrier's responsibility, however if stolen, the purchase will hardly be delivered within the promised time impacting the punctuality.

The least important criterion for both groups is the employability of local employees on delivery, with importance grade of 5.90 for customers and 7.22 for carriers.

The social criteria data is presented in Table 14.

**Table 14** - Social Criteria Data (Developed by author)

	<b>Employment</b>					
	<b>Speed</b>	<b>Punctuality</b>	<b>Return Easiness</b>	<b>of local labor</b>	<b>Theft possibility</b>	<b>Scheduling Availability</b>
São Paulo city Average	8.52	9.56	8.84	5.90	6.87	5.96
<i>São Paulo city Standard Deviation</i>	1.81	1.05	1.79	3.38	3.43	3.48
Low HDI City Hall Region Average	8.92	9.69	9.04	6.79	7.21	7.13
<i>Low HDI City Hall Region Standard Deviation</i>	1.85	0.72	1.54	3.31	3.52	3.42
Medium HDI City Hall Region Average	8.65	9.74	8.85	6.40	7.31	6.24
<i>Medium HDI City Hall Region Standard Deviation</i>	1.63	0.65	1.74	3.01	3.17	3.26
High HDI City Hall Region Average	8.12	9.28	8.70	4.77	6.17	4.87
<i>High HDI City Hall Region Standard Deviation</i>	1.91	1.45	1.99	3.54	3.56	3.46
Carrier Average	9.44	9.89	8.33	7.22	8.50	7.00
<i>Carrier Standard Deviation</i>	0.94	0.40	2.01	2.46	2.16	2.61

Customers from low HDI City Hall Region give more importance to the speed of delivery (8.92), return easiness (9.04) and scheduling availability (7.31) than the other groups. As shown in the previous sections, this audience is in the most distant regions of the city center, having longer transit times and

more incurrences of different types of deliveries due to risky areas, so this could be related to this appreciation to this criteria in order to have more convenience in the e-commerce delivery.

Regarding the risk of theft criterion as mentioned previously, carriers generally care more than customers, however there is a difference in concern between the groups: customers from regions where there are risky areas – low (7.21) and medium HDI (7.31) are more concerned with the topic than customers from the high HDI region (6.17) there is no risk.

The same behavior of more importance in low and medium HDI regions happens regarding local employability. The importance of this criterion in the high HDI region was only 6.17

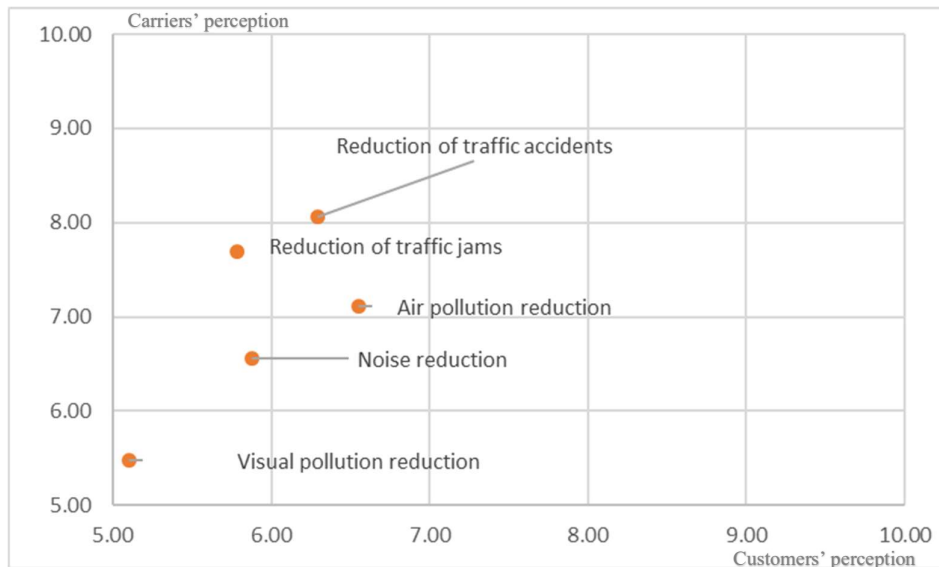
So it is noted that in the cluster of social criteria there is a greater distinction between the importances given between the regions of the city. Except for the ease of return criterion, for all others the degree of importance given by the carriers is greater than that given by the customers.

#### **4.2.3 Environmental Cluster Criteria**

In this section the general perceptions of the environmental criteria were analyzed.

The environmental cluster addressed the questions regarding the importance of the reduction of traffic jams, reduction of traffic accidents and air, noise and visual pollution reduction. These points were raised by the literature and were very well discussed in the last era of study related to city logistics, as shown on systematic review.

In the Figure 18 is shown the general perception of all customers in São Paulo city versus carriers' perception.



**Figure 18** - Environmental Criteria: São Paulo city (Developed by author)

It is observed that, in general, this cluster received lower marks of importance by carriers and consumers, having points positioned to the left and bottom of the graphs comparing to the other clusters.

In opposition to what has been discussed regarding city logistics in other markets such as the United States and Europe, in the city of São Paulo, Brazil, this cluster has less importance in the purchase by e-commerce customers and delivery decisions by carriers.

Comparing the analyzed criteria in this cluster, the least relevant for customers (5.10) and carriers (5.47) was the possibility to reduce the visual pollution; while the most relevant criterion for customers was air pollution reduction (6.58) and for carriers the reduction of traffic accidents (8.06).

Again, the degree of importance given by carriers in all criteria is greater than the importance given by customers in the environmental cluster. The complete data is presented in Table 15.

**Table 15** - Environmental Criteria Data (Developed by author)

	<b>Reduction of traffic jams</b>	<b>Reduction of traffic accidents</b>	<b>Air pollution reduction</b>	<b>Noise reduction</b>	<b>Visual pollution reduction</b>
São Paulo city Average	5.78	6.30	6.55	5.88	5.10
<i>São Paulo city Standard Deviation</i>	3.47	3.67	3.58	3.66	3.70
Low HDI City Hall Region Average	6.29	6.60	6.77	6.00	5.77
<i>Low HDI City Hall Region Standard Deviation</i>	3.52	3.64	3.66	3.88	3.82
Medium HDI City Hall Region Average	6.58	7.28	7.38	6.69	5.68
<i>Medium HDI City Hall Region Standard Deviation</i>	2.98	3.15	2.91	3.09	3.38
High HDI City Hall Region Average	4.59	5.06	5.54	4.94	4.03
<i>High HDI City Hall Region Standard Deviation</i>	3.63	3.88	3.93	3.88	3.73
Carrier Average	7.69	8.06	7.11	6.56	5.47
<i>Carrier Standard Deviation</i>	2.38	2.47	3.11	3.00	3.21

This cluster is also where, in general, was noted the largest standard deviations in relation to the degree of importance of consumers and carriers, showing that there is a divergence between opinions in each group, perhaps due to the recentness of the environmental subject.

For all criteria, customers from medium HDI City Hall Region give more importance comparing to the other groups. Also for all criteria, the least importance degree happens in the high HDI city hall region, which shows that despite higher incomes and higher education levels, these people do not have greater environmental awareness in their e-commerce purchases.

Result suggest that this cluster is still little explored in the e-commerce segment in the city of São Paulo.

#### **4.2.4 Infrastructure Cluster Criteria**

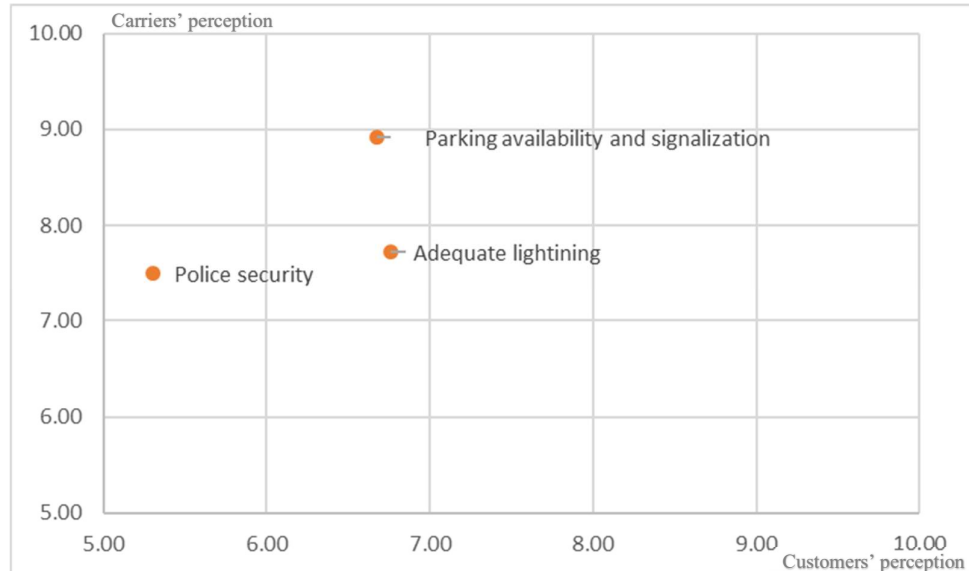
In this section the general perceptions of the infrastructure criteria were analyzed.

The infrastructure cluster addressed the questions regarding the importance of parking availability and signalization for unloading, police security and adequate lighting during night deliveries. All these points are obligation of the Government to provide and manage in municipal and State



levels.

In the Figure 19 is shown the general perception of all customers in São Paulo city versus carriers' perception.



**Figure 19** - Infrastructure Criteria: São Paulo city (Developed by author)

For all infrastructure criteria, the importance given by carriers are greater than the value given by customers. This point is shown to be logical since the carriers are actors in the delivery process and demand the infrastructure to realize the last mile delivery, the lack of infrastructure makes delivery difficult.

It is important to highlight that the criterion whose carriers gave more importance, the parking availability and signalization (8.92), was also widely mentioned during the preliminary interviews such as the difficulty of parking the vehicle, what forces them during last mile deliveries in São Paulo city to have an extra employee, the carrier helper to realize the delivery while the driver keeps in the vehicle in different regions of the city.

The infrastructure criteria data is presented in Table 16.

**Table 16** - Infrastructure Criteria Data (Developed by author)

	<b>Availability and identification of place for unloading</b>	<b>Police security</b>	<b>Adequate lighting</b>
São Paulo city Average	6.67	5.30	6.76
<i>São Paulo city Standard Deviation</i>	3.29	3.49	3.39
Low HDI City Hall Region Average	7.42	6.67	7.85
<i>Low HDI City Hall Region Standard Deviation</i>	2.91	3.28	3.02
Medium HDI City Hall Region Average	7.43	6.04	7.26
<i>Medium HDI City Hall Region Standard Deviation</i>	2.80	3.18	2.98
High HDI City Hall Region Average	5.36	3.58	5.48
<i>High HDI City Hall Region Standard Deviation</i>	3.63	3.26	3.66
Carrier Average	8.92	7.50	7.72
<i>Carrier Standard Deviation</i>	1.11	2.60	2.54

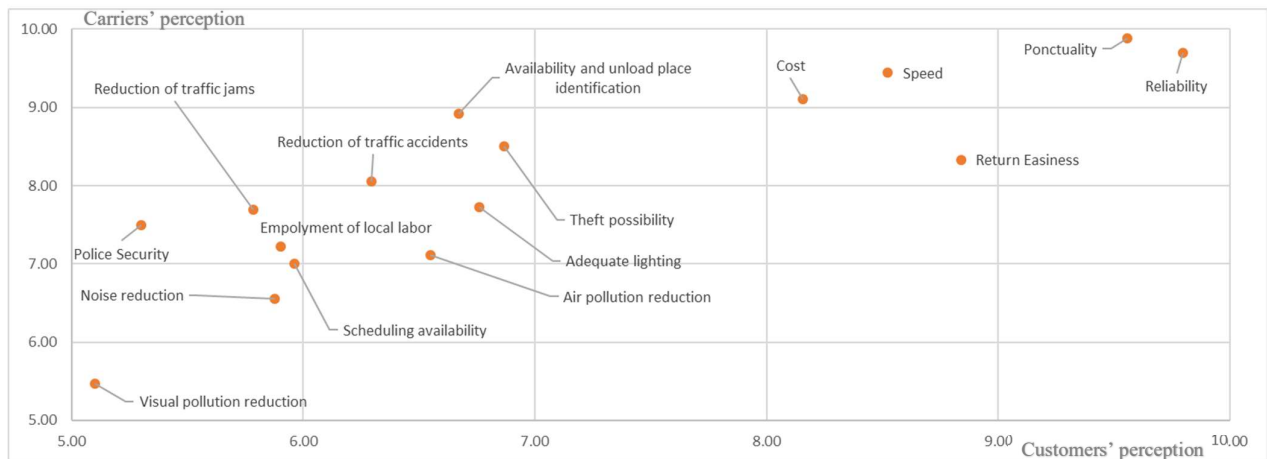
Customers from low HDI City Hall Region give more importance to all the criteria from this cluster comparing to other regions: Parking availability and signalization (7.42), police security (6.67) and adequate lightning (7.85), in some of the these neighborhoods there is some precariousness in the infrastructure, therefore greater demand and appreciation of it. In the opposite side, places that have better infrastructure (high HDI region), people do not credit so much importance to these criteria: Parking availability and signalization (5.36), police security (3.58) and adequate lightning (5.48).

Another interesting point to highlight is the importance given to police security during e-commerce last mile delivery. Carriers give greater importance (7.50), followed by consumers of low HDI region (6.67), medium HDI region (6.04) and high HDI region (3.26) showing that the concern with security is directly proportional to the number of risk areas in each of the regions.

#### **4.2.5 Discussions**

In this section the general perceptions of all clusters criteria were analyzed in a consolidated way.

In the Figure 20 is shown the general perception of all customers in São Paulo city versus carriers' perception.



**Figure 20** - General importance in last mile delivery for e-commerce (Developed by author)

Based on Figure 20 it is possible to discuss two main points based on the consolidation of answers from customers and carriers regarding the e-commerce last mile delivery in the city of São Paulo.

In general, carriers have a higher degree of prioritization than customers, giving greater importance to most points evaluated. In only two out of sixteen criteria the amount given by customers was higher than that given by carriers: reliability (customers 9.80 x carriers 9.69) and return easiness (customers 8.84 x carriers 8.33).

Another point to highlight is that despite the constant discussions regarding city logistics problems, customers and carriers in São Paulo city still crediting greater importance in topics related to performance and convenience, compared to infrastructure and environment. Such points do not highlight the growing concern with the environment and infrastructure brought by the concept of urban logistics as presented in the literature review.

#### 4.2.5.1 Pick-up alternative as new Delivery solution

As presented in the systematic review after discussions involving urban logistics issues, in the “fourth age”, from 2016 to 2018, authors concentrated their efforts to propose solutions and alternatives for the last mile e-commerce challenges, with new tools and technologies to support it.

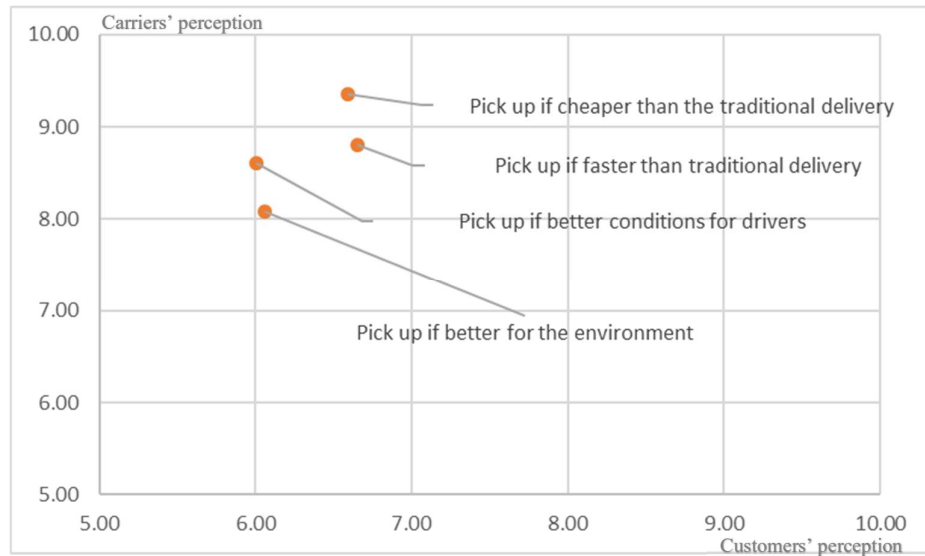
In the vast majority of studies pick up points are seen as a good

solution. This is an alternative that contrasts to the traditional delivery where the customer receive his/her purchase at an address chosen by him/her and in this new delivery way the delivery is done in a consolidator point and the customer needs to pick up his/her order at a specific address.

It is also important to highlight that for each of these innovation, there is a range of operational, business, legal and behavioural problems that need to be considered (PUNEL AND STATHOPOULOS, 2017).

Pick up points have potential to reduce last mile efforts, however some concerns as the customer perception and where those are located were raised by specialists and demand deep investigation. So, in the questionnaire was also done the assess of the acceptance of consumers and carriers to opt for this new delivery solution, in case to have any improvement in some of previous analysed criterion. The same breakdown by São Paulo city regions according to the HDI was also made in this assessment.

In the Figure 21 is shown the general perception of all customers in São Paulo city versus carriers' perception regarding pick up point implementation.



**Figure 21** - Pick up as a delivery solution (Developed by author)

In the figure it is possible to note that in general the carriers are more open (8.72) than customers (6.33) to the possibility of implementing pick-ups in São Paulo.

Note that carriers considering all the criteria that could be improved

(environment, cost, speed and better conditions for drivers) prioritize the reduction in their cost (9.36), while consumers are more likely to use pick up points in case of speed improvement (6.66). These results are in line with the preference criteria given by them in the previous sections, again there is a preference for operational indicators over socio-environmental criteria.

At the other end, the lowest consumer ratings were given for using pick up points in order to have better conditions for drivers (6.01), while for carriers if environmental improvements (8.08).

Although customer ratings being lower than those of carriers, it is important to note that the theme is still incipient in the city of São Paulo and little practiced by the largest e-commerce players according to the interviews, so there is still a lack of knowledge regarding the customer experience using pick up points in the city. So customers do not know exactly how it works and its benefits and even so, had scores above the average of the questionnaire (5). For this reason, the relevance of the research proves to be important for the e-commerce segment and for the city of São Paulo in order to raise these points and present to e-commerce players, customers and Government.

Data considering the HDI City Hall regions classification is presented in Table 17.

**Table 17** -Perception regarding pick up points as a delivery alternative in São Paulo city (Developed by author)

	<b>Pick up if faster than traditional delivery</b>	<b>Pick up if cheaper than traditional delivery</b>	<b>Pick up if better for the environment</b>	<b>Pick up if better conditions for drivers</b>
São Paulo city Average	6.66	6.59	6.06	6.01
<i>São Paulo city Standard Deviation</i>	3.20	3.31	3.47	3.51
Low HDI City Hall Region Average	7.65	7.52	6.79	6.46
<i>Low HDI City Hall Region Standard Deviation</i>	2.81	2.74	3.21	3.45
Medium HDI City Hall Region Average	7.01	6.93	6.50	6.75
<i>Medium HDI City Hall Region Standard Deviation</i>	2.91	3.21	3.13	3.29
High HDI City Hall Region Average	5.59	5.58	5.09	4.91
<i>High HDI City Hall Region Standard Deviation</i>	3.47	3.54	3.80	3.55
Carrier Average	8.81	9.36	8.08	8.61
<i>Carrier Standard Deviation</i>	1.79	1.05	2.47	2.02

In table 17 is possible to check that customers from low HDI City Hall Region (7.10) support more than others to use pick up points in future e-commerce purchases. In general this susceptibility decreases between the medium (6.80) and high (5.29) groups, in that order. Some neighbourhoods, already stigmatized as risky regions, consumers have difficulty to have some services (OLIVEIRA, 2020).

It is important to note that low city hall region has more delivery restrictions and the delivery guarantee can be considered attractive by customers using pick up points.

In the group of people who currently have deliveries made in the lower HDI City Hall region, the biggest reason for change the traditional delivery to pick-ups is due to speed (7.65) followed by cost (7.52), environment (6.79) and better conditions for drivers (6.46).

For people in the Medium HDI City Hall region, the biggest reason for change the traditional delivery to pick-ups is also speed (7.01) followed by cost (6.93), better conditions for drivers (6.75) and environment (6.50).

For people in the High HDI City Hall region, the biggest reason for change the traditional delivery to pick-ups is also speed (5.59) followed with a minimal difference by cost (5.58). Next comes environment (5.09) and better conditions for drivers (4.91). It is important to note that of all the grades given the only one less than the average of 5 was given by this group, in this case they would be less likely to use pick up points in order to improve drivers' conditions.

In this evaluation cluster there is again an increase in the standard deviation, which is also greater as lower are the susceptibilities given by the groups to grange ( low > medium > high), showing again that there is greater divergence between opinions in each group, perhaps due to the recentness of the new delivery solution pick up point in e-commerce deliveries.

## 5. CONCLUSIONS

With this research it was possible to understand the main difficulties of city logistics as well as to understand the e-commerce market in Brazil, focused on the specificities of São Paulo city, with its representativeness in economic terms and e-commerce relevance.

After the literature review and the interviews with e-commerce transportation specialists it was possible to define the analyses clusters and the main objectives in the background of delivering goods in the e-commerce last mile in São Paulo city. Notoriously, four major evaluation clusters were identified in the decision of customers and carriers: economic, social, environmental and infrastructure.

A specific mapping of the city regarding demographic data and risk classification was carried out in order to understand its regional specificities. It was observed the existence of three sub-regions within the São Paulo with profile distinctions based in these evaluated data.

After the questionnaires distribution and the consolidation of the results, it was possible to identify the main preferences regarding e-commerce last mile delivery by carriers and customers, who in fact showed to have different demands and perceptions according to the region of the city.

In general, customers and carriers consider more relevant performance and convenience aspects in relation to e-commerce delivery. However, carriers have a greater concern with the points of infrastructure and environment, in order to make their deliveries feasible. Between the different groups in the city, people from the regions furthest from the main centers, have also shown to give more importance to issues of infrastructure and environment than people from more central regions in São Paulo city, who already have a better economic and infrastructure condition, unrestricted deliveries and no extended transit times.

In this context, were identified the preferences and perceptions based on real demand in order to determine the best alternative for e-commerce last mile deliveries, being possible to answer the central question of the research: “Which are the preferences of customers and transportation providers to decide the best delivery alternative in the last mile considering the complexity scenario of the e-commerce?”.

It was observed that delivery in pick up points has emerged as a proposal for São Paulo city, being very well accepted by carriers and with some tendency of consumers acceptance, especially in some neighborhoods and in case of performance improvement from customer's point of view.

The analyses showed that the carriers are very favourable to the adoption of centralized delivery points, regardless of the reason that they would be improved with this use. Customers, on the other hand, were more reluctant to this use, but still with favourable results (average above 5).

In some regions of the city, such as the neighbourhoods with lower HDI, the adoption of pick up points is better accepted due to its benefits. It may even be a good implementation suggestion for carriers, starting a project as pilot in this specific regions.

The use of this new delivery solution would benefit consumers in having more access, which could even result in an increase in order's frequency, since they have a frequency just below the others. As so bringing benefits to São Paulo' society as a whole, in a socio-environmental perspective.

It is important to highlight that the research was concentrated in the demographical data from São Paulo, as the perception of consumers and carriers in this specific city. Therefore, the conclusions reached here should be extended to other contexts and regions for validation purposes regarding Brazil e-commerce delivery scenario as all.

In general, the change in local preference regarding socio-environment aspects is a little slower than that found today in the literature for other markets such as Europe and United States, perhaps due to a lack of perception or also due to lower sales volumes for e-commerce than in these locations.

For future studies we may seek to build a specific risk database for theft of e-commerce deliveries integrating Correios and Private carriers' occurrences. Today nonexistent in the market either through police stations or Correios.

More recent studies involving risk analysis also show dynamism, and the application of artificial intelligence could be a good alternative for this accurate mapping.

Future studies could be developed using operational research and/or simulation tools in order to identify the exactly location for pick up points



installing in order to be convenient for customers and carriers.

It is also possible to detail which specific type of pick up point (automatic, conventional, stores, etc.) would be most convenient for customers and carriers, evaluating the improvements into the clusters in their perceptions.

In this research, there was a cut between the delivery alternatives (traditional delivery and the use of pick up points), however the literature also proposed other new delivery solutions in order to incorporate to the traditional delivery that reaches customer's address. In this way, joint studies mixing the options can be a good way to further understand the profile of carriers and consumers, their awareness of the problem of city logistics and how to offer better conditions to society as a whole.

## REFERENCES

- ALLEN, J. *et al.* Understanding the impact of e-commerce on last-mile light goods vehicle activity in urban areas: The case of London. **Transportation Research Part D: Transport and Environment**, n. July, p. 0–1, 2017.
- ALVES, C. S., CHAVES, R. P., PENTEADO, I. M., COSTA, S. A. . **A IMPORTÂNCIA DA LOGÍSTICA PARA O E-COMMERCE: O EXEMPLO DA AMAZON.COM**. Disponível em: <<http://tecspace.com.br/paginas/aula/faccamp/TI/Texto07.pdf>>.
- ANTÚN, J. P. Microsoft Word - NT Antún, volumen II, 1ª prueba, todas las notas cuadros 2-1. 2013.
- BARBETTA, P. A. Cap 03 - Técnicas de amostragem. **Estatística aplicada às ciências sociais**, 2002.
- CÁRDENAS, I.; BECKERS, J.; VANELSLANDER, T. E-commerce last-mile in Belgium: Developing an external cost delivery index. **Research in Transportation Business and Management**, v. 24, n. July, p. 123–129, 2017.
- CASELLA, M. **Europe’s cargo theft troubles** Risk Management. 58.9, , 2011.
- CASTILLO, V. E. *et al.* Crowdsourcing Last Mile Delivery: Strategic Implications and Future Research Directions. **Journal of Business Logistics**, v. 39, n. 1, p. 7–25, 2018.
- CHAER, M. **Os desafios da logística de e-commerce e os benefícios para os consumidores**. Disponível em: <<https://www.ecommercebrasil.com.br/artigos/os-desafios-da-logistica-de-e-commerce-e-os-beneficios-para-os-consumidores/>>.
- CHEN, M. C. *et al.* Ensuring the quality of e-shopping specialty foods through efficient logistics service. **Trends in Food Science and Technology**, v. 35, n. 1, p. 69–82, 2014.
- CHERRETT, T. *et al.* Logistics impacts of student online shopping – Evaluating delivery consolidation to halls of residence. **Transportation Research Part C: Emerging Technologies**, v. 78, p. 111–128, 2017.
- CHIARA, M. DE. **Empresas de e-commerce evitam ‘CEPs do inferno’**. Disponível em: <<https://economia.estadao.com.br/noticias/geral,empresas-de-e-commerce-evitam-ceps-do-inferno,70001952810>>.
- COMI, A.; NUZZOLO, A. Exploring the relationships between e-shopping attitudes and urban freight transport. v. 12, n. June 2015, p. 399–412, 2016.
- COUNCIL OF SUPPLY CHAIN MANAGEMENT PROFESSIONALS. **Logistics**. Disponível em: <<https://cscmp.org/>>.
- CRAINIC, T. G.; RICCIARDI, N.; STORCHI, G. Models for Evaluating and Planning City

- Logistics Systems. **Transportation Science**, v. 43, n. 4, p. 432–454, 2009.
- DEUTSCH, Y.; GOLANY, B. A parcel locker network as a solution to the logistics last mile problem. **International Journal of Production Research**, v. 56, n. 1–2, p. 251–261, 2018.
- DISTEFANO, N.; LEONARDI, S.; CONSOLI, F. Drivers' Preferences for Road Roundabouts: A Study based on Stated Preference Survey in Italy. **KSCE Journal of Civil Engineering**, v. 23, n. 11, p. 4864–4874, 2019.
- DUCRET, R. Parcel deliveries and urban logistics: Changes and challenges in the courier express and parcel sector in Europe - The French case. **Research in Transportation Business and Management**, v. 11, p. 15–22, 2014.
- DUIN, J. H. R. VAN *et al.* Improving Home Delivery Efficiency by Using Principles of Address Intelligence for B2C Deliveries. **Transportation Research Procedia**, v. 12, n. June 2015, p. 14–25, 2016.
- DUTRA, N. G. DA S.; NOVAES, A. G. N.; MOREIRA, M. E. P. Novos Conceitos e Tecnologias na Distribuição Urbana de Mercadorias. **XXVI ENEGEP**, p. 1–9, 2006.
- DUTRA, N. G. S. **O enfoque de “city logistics”**. [s.l.] Universidade Federal de Santa Catarina, 2004.
- E-BIT. **Webshoppers 38**. [s.l.: s.n.]. Disponível em: <<https://www.ebit.com.br/webshoppers>>.
- EHMKE, J. F. **Integration of Information and Optimization Models for Routing in City Logistics**. New York: Springer, 2012.
- FECOMERCIO. Negócios Prejuízos causados pelo roubo de cargas afetam cadeia de comércio eletrônico. p. 5, 2017.
- FERRUCCI, F.; BOCK, S. Real-time control of express pickup and delivery processes in a dynamic environment. **Transportation Research Part B: Methodological**, v. 63, p. 1–14, 2014.
- GALVÃO, C. 86% dos casos de roubo de cargas em SP acontece nas periferias e produtos de menor valor são mais visados, diz estudo. **G1 SP**, 28 set. 2019.
- GARCIA, H. E-Commerce. **Journal of Innovation, Projects and Technologies – JIPT**, v. 4, p. 240–252, 2016.
- GHAJARGAR, M.; ZENEZINI, G.; MONTANARO, T. Home delivery services: innovations and emerging needs. **IFAC-PapersOnLine**, v. 49, n. 12, p. 1371–1376, 2016.
- GOULD, J. Driven to Shop? Role of Transportation in Future Home Shopping. **Transportation Research Record**, 1998.
- HARRINGTON, T. S.; SRAI, J. S.; KUMAR, M. The Management of Operations Identifying design criteria for urban system ‘ last- mile ’ solutions – a multi-stakeholder perspective. v.

7287, n. May, 2016.

IBGE. **No Title**. Disponível em: <<https://cidades.ibge.gov.br/brasil/sp/sao-paulo/panorama>>.

IPC. Strategic Perspectives on the Postal Market. n. May, p. 1–71, 2015.

\_\_\_\_. **Underpinning postal growth**. [s.l: s.n.]. Disponível em: <<https://www.ipc.be/about-ipc/reports-library/ipc-reports-brochures/annual-review2016>>.

KEDIA, A.; KUSUMASTUTI, D.; NICHOLSON, A. Acceptability of collection and delivery points from consumers' perspective: A qualitative case study of Christchurch city. **Case Studies on Transport Policy**, v. 5, n. 4, p. 587–595, 2017.

KIBA-JANIAK, M.; CHEBA, K. How Local Authorities are Engaged in Implementation of Projects Related to Passenger and Freight Transport in Order to Reduce Environmental Degradation in the City. **Procedia - Social and Behavioral Sciences**, v. 151, p. 127–141, 2014.

KOTLER, P. **Administração de Marketing**. 10th. ed. São Paulo: Prentice Hall, 2000.

LIM, S. F. W. T.; SRAI, J. S. **Examining the anatomy of last-mile distribution in e-commerce omnichannel retailing: A supply network configuration approach**. [s.l: s.n.]. v. 38

MENDES, R. **Como funciona a entrega no e-commerce?** Disponível em: <<https://www.ecommercebrasil.com.br/artigos/entrega-no-e-commerce/>>.

MUÑUZURI, J. *et al.* Solutions applicable by local administrations for urban logistics improvement. **Cities**, v. 22, n. 1, p. 15–28, 2005.

MURPHY, A. J. (Re)Solving Space and Time: Fulfilment Issues in Online Grocery Retailing. **Environment and Planning A: Economy and Space**, v. 35, 2003.

NADALIN, V.; IGLIORI, D. Empty spaces in the crowd. Residential vacancy in São Paulo's city centre. **Urban Studies**, v. 54, n. 13, p. 3085–3100, 2017.

NICHOLLS, A.; WATSON, A. Implementing e-value strategies in UK retailing. **International Journal of Retail and Distribution Management**, v. 33, n. 6, p. 426–443, 2005.

OLIVEIRA, L. K. DE *et al.* Analysis of the potential demand of automated delivery stations for e-commerce deliveries in Belo Horizonte, Brazil. **Research in Transportation Economics**, v. 65, p. 34–43, 2017.

OLIVEIRA, L. K. DE *et al.* Research in Transportation Economics Analysis of the potential demand of automated delivery stations for e-commerce deliveries in Belo Horizonte, Brazil. **Research in Transportation Economics**, v. 65, p. 34–43, 2017.

OLIVEIRA, R. Quando seu bairro é definido como zona de risco por um app de transporte. **El País**, 10 jan. 2020.

PAULO, P. M. S. **No Title**. Disponível em:

- <<http://www.capital.sp.gov.br/noticia/subprefeitura-de-sapopemba-ganha-sede-e-praca-de>>.
- PAULO, S. Informes Urbanos A dinâmica do IDH-M e suas dimensões entre 2000 e 2010 no município de. p. 1–8, 2017.
- PUNAKIVI, M.; SARANEN, J. Identifying the success factors in e-grocery home delivery. **International Journal of Retail & Distribution Management**, v. 29, n. 4, p. 156–163, 2001.
- PUNAKIVI, M.; YRJÖLÄ, H.; HOLMSTRÖM, J. Solving the last mile issue: Reception box or delivery box? **International Journal of Physical Distribution and Logistics Management**, v. 31, n. 6, p. 427–439, 2001.
- PUNEL, A.; STATHOPOULOS, A. Modeling the acceptability of crowdsourced goods deliveries: Role of context and experience effects. **Transportation Research Part E: Logistics and Transportation Review**, v. 105, p. 18–38, 2017.
- SANTOS, L. J. MODERNIZAÇÃO DO CONSUMIDOR A internet e seus reflexos nas relações de consumo. p. 1–5, 2006.
- SEBRAE. **Definição de porte de estabelecimentos segundo o número de empregados**. Disponível em: <[www.sebrae.com.br/Sebrae/Portal Sebrae/Anexos/Anuario do Trabalho Na Micro e Pequena Empresa\\_2013.pdf](http://www.sebrae.com.br/Sebrae/Portal%20Sebrae/Anexos/Anuario%20do%20Trabalho%20Na%20Micro%20e%20Pequena%20Empresa_2013.pdf)>.
- SHAO, S. *et al.* Synchronizing e-commerce city logistics with sliding time windows. **Transportation Research Part E: Logistics and Transportation Review**, v. 123, n. January, p. 17–28, 2019.
- SLACK, N.; CHAMBERS, S.; JOHNSTON, R. **Administração da Produção**. [s.l.] Editora Atlas, 2009.
- SMART, P.; TRANFIELD, D.; DENYER, D. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. **British Journal of Management**, v. 14, n. 3, p. 207–222, 2003.
- SO, H.W.T., GUNASEKARAN, A., CHUNG, W. W. C. Last Mile fulfilment strategy for competitive advantage. **International Journal of Logistics Systems and Management**, v. 2, n. 4, p. 404–418, 2006.
- TANIGUCHI, E.; THOMPSON, R.G.;YAMADA, T.;DUIN, R. V. **City Logistics: Network Modelling and Intelligent Transport Systems**. Amsterdam: Pergamon, 2001.
- VAKULENKO, Y.; HELLSTRÖM, D.; HJORT, K. What’s in the parcel locker? Exploring customer value in e-commerce last mile delivery. **Journal of Business Research**, v. 88, n. November 2017, p. 421–427, 2018.
- VIEIRA, J. G. V.; FRANSOO, J. C.; CARVALHO, C. D. Freight distribution in megacities: Perspectives of shippers, logistics service providers and carriers. **Journal of Transport**

**Geography**, v. 46, p. 46–54, 2015.

VIEIRA, V. A. As tipologias, variações e características da pesquisa. **Revista FAE**, v. 5, p. 61–70, 2002.

VISSER, P. S., KROSNICK J. A., LAVRAKAS, P. J. Survey research. *In: **Handbook of research methods in social and personality psychology***. [s.l.] Cambridge University Press, 2000. p. 223–252.

WALCH, R. E. Electronic commerce. **Key Aspects of German Business Law (Fourth Edition): A Practical Manual**, v. 4, n. 2, p. 317–321, 2009.

WANG, C. *et al.* An exploration on e-retailers' home delivery – strategic elements and their prioritisation. **Business Process Management Journal**, v. 22, n. 3, p. 614–633, 2016.

WANG, X. *et al.* An innovation diffusion perspective of e-consumers' initial adoption of self-collection service via automated parcel station. **International Journal of Logistics Management**, v. 29, n. 1, p. 237–260, 2018.

WANG, X. C.; ZHOU, Y. Deliveries to residential units: A rising form of freight transportation in the U.S. **Transportation Research Part C: Emerging Technologies**, v. 58, p. 46–55, 2015.

XING, Y. *et al.* Physical distribution service quality in online retailing. **International Journal of Physical Distribution and Logistics Management**, v. 40, n. 5, p. 415–432, 2010.

XU, J. J.; HONG, L. Impact factors of choosing willingness for picking up service. **Research Journal of Applied Sciences, Engineering and Technology**, v. 6, n. 14, p. 2509–2513, 2013.

XU, M.; FERRAND, B.; ROBERTS, M. The last mile of e-commerce: unattended delivery from the consumers and eTailers' perspectives. **International Journal of Electronic Marketing and Retailing**, v. 2, n. 1, p. 20, 2008.

YIN, R. K. **Estudo de caso: planejamento e métodos**. 3. ed. Porto Alegre: Bookman, 2005.

**APPENDIX A - São Paulo City Hall Regions' demographic detail**

City Hall Region	Neighborhoods	Area (km <sup>2</sup> )	Population (2010)	Demographic density (inhabitant/km <sup>2</sup> )
<b>Aricanduva</b>	Aricanduva	6.6	89,622	13,579
	Carrão	7.5	83,281	11,104
	Vila Formosa	7.4	94,799	12,811
	<b>TOTAL</b>	<b>21.5</b>	<b>267,702</b>	<b>12,451</b>
<b>Butantã</b>	Butantã	12.5	54,196	4,336
	Morumbi	11.4	46,957	4,119
	Raposo Tavares	12.6	100,164	7,95
	Rio Pequeno	9.7	118,459	12,212
	Vila Sônia	9.9	108,441	10,954
	<b>TOTAL</b>	<b>56.1</b>	<b>428,217</b>	<b>7,633</b>
<b>Campo Limpo</b>	Campo Limpo	12.8	211,361	16,513
	Capão Redondo	13.6	268,729	19,759
	Vila Andrade	10.3	127,015	12,332
	<b>TOTAL</b>	<b>36.7</b>	<b>607,105</b>	<b>16,542</b>
<b>Capela do Socorro</b>	Cidade Dutra	29.3	196,36	6,702
	Grajaú	92	360,787	3,922
	Socorro	12.9	37,783	2,929
	<b>TOTAL</b>	<b>134.2</b>	<b>594,93</b>	<b>4,433</b>
<b>Casa Verde</b>	Cachoeirinha	13.3	143,523	10,791
	Casa Verde	7.1	85,624	12,06
	Limão	6.3	80,229	12,735
	<b>TOTAL</b>	<b>26.7</b>	<b>309,376</b>	<b>11,587</b>
<b>Cidade Ademar</b>	Cidade Ademar	12	266,681	22,223
	Pedreira	18.7	144,317	7,717
	<b>TOTAL</b>	<b>30.7</b>	<b>410,998</b>	<b>13,388</b>
<b>Cidade Tiradentes</b>	Cidade Tiradentes	15	211,501	14,1
<b>Ermelino Matarazzo</b>	Ermelino Matarazzo	8.7	113,615	13,059
	Ponte Rasa	6.4	93,894	14,671
	<b>TOTAL</b>	<b>15.1</b>	<b>207,509</b>	<b>13,742</b>
<b>Freguesia do Ó</b>	Brasilândia	21	264,918	12,615
	Freguesia do Ó	10.5	142,327	13,555
	<b>TOTAL</b>	<b>31.5</b>	<b>407,245</b>	<b>12,928</b>
<b>Guaianases</b>	Lajeado	9.2	103,996	12,093
	Guaianazes	8.6	164,512	17,882

	<b>TOTAL</b>	<b>17.8</b>	<b>268,508</b>	<b>15,085</b>
<b>Ipiranga</b>	Cursino	12.8	109,088	8,523
	Ipiranga	10.5	106,865	10,178
	Sacomã	14.2	247,851	17,454
	<b>TOTAL</b>	<b>37.5</b>	<b>463,804</b>	<b>12,368</b>
<b>Itaim Paulista</b>	Itaim Paulista	12	224,074	18,673
	Vila Curuçá	9.7	149,053	15,366
	<b>TOTAL</b>	<b>21.7</b>	<b>373,127</b>	<b>17,195</b>
<b>Itaquera</b>	Cidade Líder	10.2	126,597	12,411
	Itaquera	14.6	204,871	14,032
	José Bonifácio	14.1	124,122	8,803
	Parque do Carmo	15.4	68,258	4,432
	<b>TOTAL</b>	<b>54.3</b>	<b>523,848</b>	<b>9,647</b>
<b>Jabaquara</b>	Jabaquara	14.1	223,78	15,871
<b>Jaçanã</b>	Jaçanã	7.8	94,609	12,129
	Tremembé	56.3	197,258	3,504
	<b>TOTAL</b>	<b>64.1</b>	<b>291,867</b>	<b>4,553</b>
<b>Lapa</b>	Barra Funda	5.6	14,383	2,568
	Jaguara	4.6	24,895	5,412
	Jaguaré	6.6	49,863	7,555
	Lapa	10	65,739	6,574
	Perdizes	6.1	111,161	18,223
	Vila Leopoldina	7.2	39,485	5,484
	<b>TOTAL</b>	<b>40.1</b>	<b>305,526</b>	<b>7,619</b>
<b>M'Boi Mirim</b>	Jardim Ângela	37.4	295,434	7,899
	Jardim São Luís	24.7	267,871	10,845
	<b>TOTAL</b>	<b>62.1</b>	<b>563,305</b>	<b>9,071</b>
<b>Mooca</b>	Água Rasa	6.9	84,963	12,313
	Belém	6	45,057	7,51
	Brás	3.5	29,265	8,361
	Mooca	7.7	75,724	9,834
	Pari	2.9	17,299	5,965
	Tatuapé	8.2	91,672	11,18
	<b>TOTAL</b>	<b>35.2</b>	<b>343,98</b>	<b>9,772</b>
<b>Parelheiros</b>	Marsilac	200	8,258	41
	Parelheiros	153.5	131,183	855
	<b>TOTAL</b>	<b>353.5</b>	<b>139,441</b>	<b>394</b>
<b>Penha</b>	Artur Alvim	6.6	105,269	15,95
	Cangaíba	16	136,623	8,539
	Penha	11.3	127,82	11,312



	Vila Matilde	8.9	104,967	11,792
	<b>TOTAL</b>	<b>42.8</b>	<b>474,659</b>	<b>11,09</b>
<b>Perus</b>	Anhanguera	33.3	65,859	1,978
	Perus	23.9	80,187	3,355
	<b>TOTAL</b>	<b>57.2</b>	<b>164,046</b>	<b>2,553</b>
<b>Pinheiros</b>	Alto de Pinheiros	7.7	43,117	5,6
	Itaim Bibi	9.9	92,57	9,351
	Jardim Paulista	6.1	88,692	14,54
	Pinheiros	8	65,364	8,171
	<b>TOTAL</b>	<b>31.7</b>	<b>289,743</b>	<b>9,14</b>
<b>Pirituba</b>	Jaraguá	27.6	184,818	6,696
	Pirituba	17.1	167,931	9,821
	São Domingos	10	84,843	8,484
	<b>TOTAL</b>	<b>54.7</b>	<b>437,592</b>	<b>8</b>
<b>Santana</b>	Mandaqui	13.1	107,58	8,212
	Santana	12.6	118,797	9,428
	Tucuruvi	9	98,438	10,938
	<b>TOTAL</b>	<b>34.7</b>	<b>324,815</b>	<b>9,361</b>
<b>Santo Amaro</b>	Campo Belo	8.8	65,752	7,472
	Campo Grande	13.1	100,713	7,688
	Santo Amaro	15.6	71,56	4,587
	<b>TOTAL</b>	<b>37.5</b>	<b>238,025</b>	<b>6,347</b>
<b>São Mateus</b>	Iguatemi	19.6	127,662	6,513
	São Rafael	13	143,992	11,934
	São Mateus	13.2	155,14	10,908
	<b>TOTAL</b>	<b>45.8</b>	<b>426,794</b>	<b>9,319</b>
<b>São Miguel</b>	São Miguel	7.5	92,081	12,277
	Jardim Helena	9.1	135,043	14,84
	Vila Jacuí	7.7	142,372	18,49
	<b>TOTAL</b>	<b>24.3</b>	<b>369,496</b>	<b>15,206</b>
<b>Sapopemba</b>	Sapopemba	13.5	284,524	21,076
<b>Sé</b>	Bela Vista	2.6	69,46	26,715
	Bom Retiro	4	33,892	8,473
	Cambuci	3.9	36,948	9,474
	Consolação	3.7	57,365	15,504
	Liberdade	3.7	69,092	18,674
	República	2.3	56,981	24,774
	Santa Cecília	3.9	83,717	21,466
	Sé	2.1	23,651	11,262
	<b>TOTAL</b>	<b>26.2</b>	<b>431,106</b>	<b>16,454</b>
	Vila Guilherme	6.9	54,331	7,874

<b>Vila Maria/Vila Guilherme</b>	Vila Maria	11.8	113,463	9,616
	Vila Medeiros	7.7	129,919	16,873
	<b>TOTAL</b>	<b>26.4</b>	<b>297,713</b>	<b>11,277</b>
<b>Vila Mariana</b>	Moema	9	83,368	9,263
	Saúde	8.9	130,78	14,694
	Vila Mariana	8.6	130,484	15,173
	<b>TOTAL</b>	<b>26.5</b>	<b>344,632</b>	<b>13,005</b>
<b>Vila Prudente</b>	São Lucas	9.9	142,347	14,378
	Vila Prudente	9.9	104,242	10,529
	<b>TOTAL</b>	<b>19.8</b>	<b>246,589</b>	<b>12,454</b>

**Source:** (PREFEITURA MUNICIPAL DE SÃO PAULO, 2017)

## APPENDIX B - Questionnaires (Portuguese)

C1 - Onde você costuma receber suas compras feitas pela internet?	-
C2 - Em que bairro da cidade de São Paulo está localizado seu principal endereço de entrega?	T1- Qual o porte da empresa em que trabalha?
C3 - Há quanto tempo realiza compras pela internet?	T2 - Qual seu tempo de experiência neste segmento?
C4 - Quantas compras pela internet você realizou nos últimos 12 meses?	T3 - Qual seu cargo atual de atuação?
C5 - Qual sua faixa etária?	T4 - Quantos pedidos on-line sua empresa entregou aproximadamente nos últimos 12 meses?
C6 - Qual a importância do custo do frete ao realizar compras pela internet?	T5 - Qual a importância do custo do frete no serviço de entrega que oferece?
C7 - Qual a importância da rapidez da entrega ao realizar compras pela internet?	T6 - Qual a importância da rapidez no serviço de entrega que oferece?
C8 - Qual a importância de receber suas compras pela internet dentro do prazo estipulado pelo vendedor?	T7 - Qual a importância de atender o prazo estipulado no serviço de entrega que oferece?
C9 - Qual a importância de receber os produtos sem avarias ao realizar compras pela internet?	T8 - Qual a importância de entregar produtos sem avarias no serviço de entrega que oferece?
C10 - Ao comprar pela internet, qual a importância você dá para a facilidade de devolver seu produto caso necessário?	T9 - Qual a importância você dá a facilidade de coleta de uma entrega de um cliente caso necessário?
C11 - Ao comprar pela internet, qual a importância da a possibilidade de empregar mão de obra local para fazer sua entrega?	T10 - Qual a importância você dá para a geração de empregos no bairro ao utilizar entregadores locais em sua decisão de entrega?
C12 - Ao comprar pela internet, qual a importância dá para a possibilidade de roubo da mercadoria durante a entrega?	T11 - Qual a importância você dá para a possibilidade da carga ser roubada durante o transporte no serviço de entrega que oferece?
C13 - Qual a importância do agendamento de data e horário de entrega ao se comprar pela internet?	T12 - Quão importante é a possibilidade do cliente escolher data e horário de entrega no serviço de entrega que oferece?
C14 - Ao comprar pela internet, qual a importância da possibilidade de redução de congestionamentos de trânsito ao se fazer a entrega?	T13 - Quão importante é a possibilidade de reduzir congestionamentos de trânsito no serviço de entrega que oferece?
C15 - Ao comprar pela internet, qual a importância da possibilidade de redução de acidentes de trânsito ao se fazer a entrega?	T14 - Quão importante é a possibilidade de reduzir acidentes de trânsito no serviço de entrega que oferece?
C16 - Ao comprar pela internet, qual a importância da possibilidade de redução de poluição do ar ao se fazer a entrega?	T15 - Quão importante é a possibilidade de reduzir a poluição do ar no serviço de entrega que oferece?
C17 - Ao comprar pela internet, qual a importância da possibilidade de redução de poluição sonora ao se fazer a entrega?	T16 - Quão importante é a possibilidade de reduzir a poluição sonora no serviço de entrega que oferece?
C18 - Ao comprar pela internet, qual a importância da possibilidade de redução de poluição visual ao se fazer a entrega?	T17 - Quão importante é a possibilidade de reduzir a poluição visual no serviço de entrega que oferece?
C19 - Ao comprar pela internet, qual a importância de o(a) motorista dispor de local adequado e bem sinalizado para o carregamento/descarregamento ao fazer a entrega?	T18 - Quão importante é a possibilidade do(a) motorista não concluir a entrega em virtude de não encontrar local adequado e sinalizado de carga e descarga, no serviço de entrega que oferece?
C20 - Ao comprar pela internet, qual a importância de o(a) motorista dispor de segurança policial ao se fazer a entrega?	T19 - Quão importante é a segurança policial no serviço de entrega que oferece?
C21 - Ao comprar pela internet, qual a importância de o(a) motorista dispor de iluminação adequada ao se efetuar entregas noturnas?	T20 - Quão importante é dispor de iluminação adequada na rua para as entregas noturnas, na sua decisão de entrega?
C22 - Ao comprar pela internet, quão disposto estaria a buscar seu pedido em um local escolhido por você (ex: guarda volumes, estações de metrô, postos de gasolina, etc) se o prazo de entrega fosse mais rápido?	T21 - Quão disposto estaria a entregar os pedidos dos clientes em um local central (ex: guarda volumes, estações de metrô, postos de gasolina, etc) caso conseguisse ofertar prazos de entrega mais rápidos?
C23 - Ao comprar pela internet, quão disposto estaria a buscar seu pedido em um local escolhido por você (ex: guarda volumes, estações de metrô, postos de gasolina, etc) se o custo do frete fosse menor?	T22 - Quão disposto estaria a entregar os pedidos dos clientes em um local central (ex: guarda volumes, estações de metrô, postos de gasolina, etc) caso conseguisse reduzir seus custos de entrega?
C24 - Ao comprar pela internet, quão disposto estaria a buscar seu pedido em um local escolhido por você (ex: guarda volumes, estações de metrô, postos de gasolina, etc) se o impacto ambiental fosse reduzido?	T23 - Quão disposto estaria a entregar os pedidos dos clientes em um local central (ex: guarda volumes, estações de metrô, postos de gasolina, etc) caso conseguisse reduzir impactos ambientais gerados pelo processo de entrega?
C25 - Ao comprar pela internet, quão disposto estaria a buscar seu pedido em um local escolhido por você (ex: guarda volumes, estações de metrô, postos de gasolina, etc) se condições mais seguras fossem dadas aos motoristas?	T24 - Quão disposto estaria a entregar os pedidos dos clientes em um local central (ex: guarda volumes, estações de metrô, postos de gasolina, etc) caso conseguisse melhorar condições de entrega para motoristas ?