The Alternatives on Last Mile Delivery Logistics: Insights on Customers' Preferences

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Abstract

The last mile logistic is the delivery to the end consumer and it is the most important step when considering the entire logistical distribution process involved in e-commerce. Analyzing the process backwardly, there are many concerns about how to ensure that the product reaches the customer in a satisfactory manner, as the operations have high distribution costs, are polluting, and/or low efficient. There are several vehicles placed on route to serve different regions within the same city. There are often areas with heavy traffic that demand efficient planning of routes and delivery times. In this context, technology becomes a strong ally of the last mile. Technological revolutions over the past 60 years have enabled greater connectivity and integration in product distribution, and the adoption of smart tools connected via IoT, mobile and AI is crucial for companies that want to thrive in this environment. Based on a survey and literature review, the objective of this work is to identify which are the last mile delivery alternatives available on the market to relate them to the customer's perception regarding delivery preference, and the environmental impact inherent in the choice. As a result, this study showed that the age of the respondents is a factor that can influence their perceived safer mode of last mile delivery.

Keywords
Last mile, e-commerce, technology, sustainability, logistics.

1. Introduction
With the advance of coronavirus, everyone had to adapt to the practice of social isolation to protect themselves. Bars, shops, and restaurants were also affected by the Covid-19 pandemic and had to reinvent themselves. E-commerce has become existing even in this non-online environment and has since adapted to new customs and demands, due to social distancing. In this context, we can separate e-commerce into two phases: pre- and post-pandemic.

The pre-pandemic phase showed a greater growth in internet use and highlighted the shift of consumers to the preference of making their purchases digitally than in person in physical stores. Companies and businesses were already looking for better experiences for consumers to make e-commerce a big trend. However, although the expectation was high, it would still take years for digital commerce to exceed sales of physical stores.

During the pandemic many companies closed or reduced workloads, as a result of traffic restrictions aimed at reducing contagion among people. In this situation, companies saw no other way than to reinvent themselves and start selling through digital channels, accelerating digital transformation.

According to E-commerce Brazil (2020), Brazilian e-commerce earned R$ 9.4 billion in April 2020, an increase of 81% over the same period in 2019. The categories that had the highest volume of purchases were food and beverages, musical instruments, toys, electronics and bed, table, and bath.
This significant increase directly impacted the companies because it was necessary to review inventories, movement, storage and transportation, the latter being the one that brings the most impact on the customer's perception, because it is the stage that realizes the sales cycle and, which brings more challenges to entrepreneurs, since it involves high operating costs.

In the post-pandemic it is perceived that companies are more attentive to changes and have become more flexible, seeking excellence in customer service. The marketplace and online sales that were once a trend, have become essential for companies that have also realized the importance of investing in this digital transformation.

To achieve this goal, organizations have a great ally: technology. Increasingly present in the day-to-day, it is essential for the safety of the order and optimization of routes, besides enabling new forms of delivery capable of reducing the emission of polluting gases.

This study is important due to the increasing use of e-commerce and the impacts of its logistics, since it can cause an increase in city traffic and the emission of polluting gases. Therefore, alternatives to the last mile are essential to reduce this damage and facilitate deliveries and are critical on the customer point-of-view.

The objective of this work is to identify the main alternatives for deliveries in the last mile and what are the best options with respect to implementation and use costs, environmental impact of options, delivery time and customer preference. This information is obtained through research of other studies involving costs and how the last mile impacts the environment, and through a preference survey done through an online form with questions related to people's choices for urban logistics.

This paper is organized as follows: section 2 presents a literature review, contextualizing the pre- and post-pandemic e-commerce scenario of covid-19 and how digitization boosted this market; section 3 presents the methodology adopted in this research; section 4 presents and discuss the results; and finally, section 5 concludes this study.

2. Literature Review

In 2020, being digital was something new and seen by many companies as a market differential. However, as the year went by, digitization has become a matter of survival, bringing up a basic condition to stay in the market.

According to the Digital Transformation Index survey conducted by Vanson Bourne for Dell Technologies in 2020, 88% of Brazilian respondents believe that the company they work for successfully accelerated digital transformation in 2020, above the global average of 80%. The programs that have been further accelerated are the development of remote work capabilities and the strengthening of cybersecurity.

On the other hand, research shows that there are still barriers to be overcome such as lack of economic growth, the inability to extract valuable insights from data, and lack of financial resources to increase data and privacy security. In response to this gap, Brazilian companies intend to invest in 5G infrastructure, privacy software and data management tools over the next 1-3 years.

According to a survey conducted by Sebrae, in partnership with the Getúlio Vargas Foundation (FGV) in 2021, the pandemic stimulated the digitization of micro and small businesses. Today, 70% of these companies operate in social networks, applications, or internet to boost their sales. In May 2020, right at the beginning of the pandemic, this percentage was 59%.

We have as an example the startup Diálogo Logística de Porto Alegre, which delivers orders to retailers with an online presence, such as Magazine Luiza. During the pandemic, he found himself at risk of losing his business. To do this, they implemented voice command, with the style of personal assistants to Diálogo's application, minimizing contact and avoiding contagion among 2,000 delivery men throughout the region. According to Ricardo Hoerde, founder of Diálogo, "Instead of signing the receipt, customers say they have received the orders and the delivery men record everything".

Digital transformation has brought many practicalities and today is no longer a distant future but real and faced with various innovations. Technology brings with it the challenge of adaptation, whether with the new model of work in home office, changes in the company, cloud systems, financial software, improvements in the customer experience or with new ways of delivering online purchases.

2.1 E-commerce

E-commerce is a way of doing business, buying, and selling, totally online, where a venture makes its products available and the customer can buy through a digital platform, without a physical establishment, and can be done from anywhere and anytime.

This way of doing business tends to maintain growth, since it had 13.2 million new consumers in 2020 alone and 83% of them declared that they would buy back online, according to the Report WebShoppers 43 (2021). According to Andrade e Silva (2017, p. 9), the greatest advantages of digital purchases are low price and ease in product research. Therefore, it is perceived that this medium will become increasingly present in people's daily lives by bringing more practicality to the consumer and to the company that is marketing.

The growth trend is also noted by NeoTrust (2021), which reports that Brazilian revenues from digital trade in the first quarter of 2021 were R$35.2 billion, representing approximately 40.46% of total revenues for the year 2020. Expectations for 2021 full year are better than in previous years. According to Ebit data| Nielsen (2021), e-commerce is expected to grow 21% and have a total revenue of R$110 billion.

2.2 The Last Mile

The increase in e-commerce has brought more challenges for companies when it comes to deliveries in the last mile, such as lowering costs and deadlines and delivering the product in good condition. Added to this is the adoption of sustainable practices, increasingly demanded of logistics companies that have a certain degree of impact on the environment.

According to a study made by the World Economic Forum - WEF (2020), by 2030 it is expected that 36% of vehicles in circulation in cities are e-commerce delivery, in addition to increasing congestion by 21% and CO_2 emissions by 32%. In addition, delivery time enters as a weight factor in the new normal. While deliveries from one to three days remain the largest, same-day deliveries and instant deliveries grow 36% and 17% respectively each year. These data show the need to rely on alternatives for the last mile to improve logistics in urban centers and, it is in this scenario that technology enters as the main character.

WEF points out that many vehicle manufacturers are considering technological design concepts that help drivers, such as cameras that track delivery paths, machine learning software, automated vehicle loading systems, and advanced analytics-based driver apps.

Other ways to expedite the last mile are also already in use, such as electric vehicles, which are less harmful to the environment compared to combustion vehicles, and, bicycles, which in addition to non-polluting stimulate physical activity and reduce congestion. There are also drones, private cars and “Reception Box” points, which can be managed through applications on consumers' mobile phones.

More than reconciling new ways of delivery with more energy and environmental efficiency, it is necessary to understand what the consumer's preference is. With so many innovative alternatives that require greater rely on in software and applications, there are still those who prefer to receive their orders in the traditional way.

The “Green Button Project” is an active study conducted by the Institute of Technology of Massachusetts (MIT) regarding consumer preference for green last mile home delivery. In a simply and resumed way, the project aims to learn what are the key drivers that could motivate the consumer to wait for their deliveries and how their behaviors could be influenced by given information about environmental footprint of the shipping option.

3. Methodology

In order to identify the main alternatives for the deliveries in the last mile, the best options when considering implementation and use costs, environmental impact, delivery time and consumer’s preference, this research was divided into two parts: in the first was carried out a bibliographic analysis to give historical and theoretical basis on concepts and definitions of last mile logistics and, in the second part, a questionnaire composed of 11 questions was conducted in order to (i) know the consumer's preference regarding the last mile delivery alternatives and how aware he is of the environmental impacts linked to delivery; (ii) assess how willing they would be to give up one type of delivery over another; and (iii) evaluate the correlation between the data through a correspondence analysis.

3.1 Data Collection

The questionnaire was constructed based on inferences about ways of delivery currently known and data from surveys conducted by public and private institutions. Some rules were followed as the need for no identification of the respondent and no age limit. The questions were elaborated to correlate transportation alternatives with environmental data and consumer's preference.

Questionnaire:

1. What's your age group?
   A: 18-28 years; 29-39 years; 40-50 years; 51-60 years; more than 60 years.
2. What's your town?
   A: Open field.
3. Usually, do you get your deliveries from which way?
   A: Bicycle, Van, Car, Private Car, Motorcycle, Reception Box.
4. Knowing that the use of the bicycle decreases almost 400,000 tons of polluting gases per year, would you agree to receive your deliveries through this means of transport? Source: "Bike Economy", Bike Alliance (2018).
   A: Yes, No, maybe.
5. If the answer to the previous question is no, please justify it.
   A: Open field.
6. The delivery system with private cars is an option to reduce costs and expedite the last mile of companies, would you use this system to receive an order?
   A: Yes, No.
7. To make the last mile of companies faster and at lower cost, would you use the pick-up point system to gain access to your order faster?
   A: Yes, No.
8. The use of an electric van, alone, can reduce by 5 tons CO2 in a year, if you have the possibility to choose between electric vehicles and conventional vehicles, would you give preference to the electric? Source: Street Scooter WORK XL, Ford Motor Company (2018).
   A: Yes, No.
9. Knowing that deliveries on the same day equate to the death of 300 trees, if you wait 3 to 4 days, the delivery will now equate to the death of 10 trees. Would you agree to wait 3 to 4 days to receive your order to save more trees? Source: "Green Button Project", MIT Sustainable Logistics Initiative (2018).
   A: Yes, No.
10. Delivery by drones is an alternative that has been tested in Brazil mainly by applications that deliver food. Would you opt for this kind of service?
    A: Yes, No.
11. Of all the means cited, which one do you consider safer?
    A: Bicycle, Van, Drones, Private Car, Motorcycle, Reception Box.

Data were collected from July 12 to July 24, 2021. At the end of the questionnaire application, 102 respondents were reached of which 98 responded to the survey correctly. Next, the data were tabulated in a Microsoft Excel spreadsheet and with the use of the R software, the correspondence test analysis was performed.

3.2 Correspondence Analysis (CA)

Correspondence analysis (CA) is a multivariate statistical technique that allows simultaneous analysis of different categorical variables. These categorized variables may have nominal and ordinal measurement levels, or they may also come from discrete or continuous quantitative variables. CA is essentially an exploratory and descriptive analysis of the data that allows a graphical analysis of the interrelationships or correspondences between the variables (SILVA, 2012). It provides factor scores (coordinates) for row and column points of the contingency table. These coordinates are used to graphically visualize the association between the row and column elements in the contingency table. (STHDA, 2017).

When analyzing a two-way contingency table, a typical question is whether certain row elements are associated with some elements of column elements. Match analysis is a geometric approach to viewing the rows and columns of a two-way contingency table as points in a low-dimensional space, so that the positions of the row and column points

are consistent with their associations in the table. The goal is to have an overview of the data that is useful for interpretation. (STHDA, 2017).

4. Results and Discussion

Regarding the age of the participants, 52.53% are between 18 and 28 years old, 32.32% are between 29 and 39, from 40 to 50 years represent 7% of the answers, people between 51 and 60 years correspond to 5% of the public and 3% of respondents are over 60 years old.

The city with the most respondents was Sorocaba, representing 48% of the public, then Curitiba with 13.3% of the participants, then São Paulo with 11.2%, and the residual refers to other cities.

The most common ways that people receive their deliveries are vans and motorcycles, with 45.92% each. Then car and reception box point, with 4.08% and 2.04% respectively. The two least used means are private car and bicycle. When asked why they did not choose a bicycle, the justifications were that it would depend on the product to be delivered, for example food or fragile objects and the lack of cycle routes in their region, putting the cyclist in danger or subject to too much heat or rain.

The possibility of using private cars was well accepted, since 95.92% of the respondents said they would accept to receive their orders in this way. About the use of reception box points 67.35% of the people answered that they would make use of this alternative.

Regarding new technologies, 81.63% of participants said they would receive their deliveries by drones. In Brazil this technology is still in the testing phase and at first is linked to the delivery of meals only.

When asked about the safety of delivery, for 36.73% of participants reception box point is the safest way, followed by delivery via vans with 33.67%, third comes the use of private cars and drones, with 12.24% and 9.18% respectively, and lastly, 4.08% of respondents think that motorcycles are safer, tied with bicycles.

About the questions that presented data on environmental impacts, 79.59% of the participants answered that they would accept deliveries by bicycles, 18.37% answered that they might accept and 2.04% answered that they would not accept. As for waiting 3 to 4 days to receive the delivery, 84.69% of the answers were that they would agree to wait too many days. 97.96% of the interviewees said they would give preference to the use of electric vans over conventional vehicles to reduce the amount of CO_2 emitted.

A correspondence analysis was developed to analyze the association between the age of respondents and their perceived safer mode of distribution. Table 1 presents the eigenvalues of the main dimensions. Considering the total variation of the system explained by 86.2% by the two main dimensions, it was possible to build the correspondence graph. The chi-square statistic was 7.76 indicating an association between the ages and the mode of distribution perceived as safer in the last mile distribution.

Figure 1 illustrates those associations. It is noteworthy respondents 60 years old or older consider bicycle as the safer mode, and respondents aging from 51-60 years old consider private vehicles as safer distribution mode. Younger respondents considered other alternative distribution modes as safer ones, such as drones, vans, reception boxes and motorcycles.

Table 1. Main dimensions and their eigenvalues for the interaction between age and safer delivery mean in the last mile distribution.

Dimension	Eigenvalues	%	Cumulative %
1	0.108337	48.5	48,5
2	0.084162	37.7	86.2
3	0.025476	11.4	97,7
4	0.005234	2.3	100,00
Total Inertia --- 0.4464211			
Chi-square --- 7.764937			

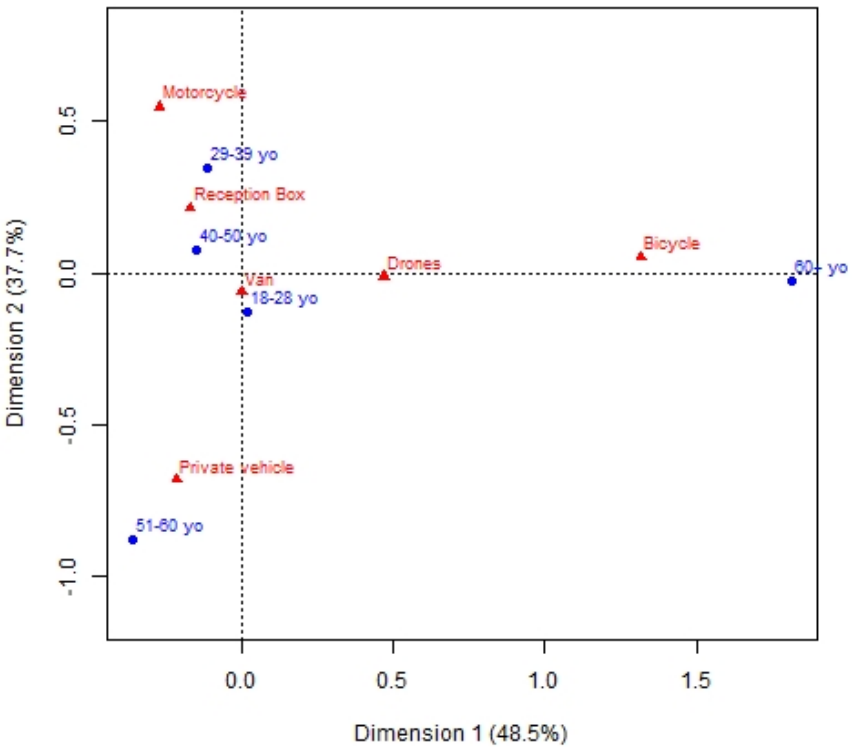

Figure 1. Correspondence chart between age and safer delivery distribution mean for last mile distribution.

The results of this study corroborate with the findings of the Green Button Project, that a consumer decision can be highly influenced when they see a minor data of environmental impact. Moreover, the present study correlated the preference with the age of the respondents, which can also give insights when analyzing safety and consumer perspective for green last mile delivery.

5. Conclusion

This paper aimed to bring for discussion the current alternatives used in last mile logistics in Brazil, acknowledge by a population sample with a range of age from 18 to 60 year or more. After one week, it was possible to gather data to analyze the customer's preference regarding different ways of receiving purchased stuffs, not limiting to food or bigger home appliances. Then we correlated the respondents age with their perceived safer mode of distribution by running a correspondence analysis test in R software.

As a result of the analysis, we could conclude that older respondents consider bicycles safer rather than drones, vans, reception boxes and motorcycles, as the younger do. However, bicycles are not the top #1 preference between customers. Giving this, we can infer that even being the safer delivery mode, the customers consulted would rather prefer to receive their deliveries in a faster or less secure way.

Limitations of this study are the number of respondents, which could be higher to generalize results, and that the answers of the respondents correspond to their opinion in a specific period of time. We must consider that the respondents' opinions can change once they get more information about other distribution modes. Future works may expand the survey questions, in order to investigate further the reasons that make respondents feel safer with a distribution mode when compared to another.

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