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Technology deployment solutions to improve passenger experience in public transportation

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Master's in Management of Services and Technology

Supervisor:

PhD Sofia Kalakou, Assistant Professor at ISCTE

Marketing Operations and General Management

ISCTE - Instituto Universitário de Lisboa

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BUSINESS
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Abstract

Public transportation plays a pivotal role in increasingly urbanized cities, facing the many challenges brought by overpopulation and pollution. To face those challenges, public transports around the world have joined the trend of technological development, introducing smart, sustainable, and more efficient systems. The realization that in Lisbon most people commute using a personal vehicle, while in Copenhagen less than one third of the citizens do so, leaves one into questioning whether the city's services are being provided appropriately to passengers. This dissertation is meant to decode if the public transportation in Lisbon is operating to its full capacity and identify any service gaps that might be filled by inserting the same policies existing in superior services. As modern times are marked by constant technological improvements, revolutionizing, and redefining the norms of yesterday, public transports in Lisbon must consider adopting smart ways to operate and level up the service quality provided to their passengers. It is anticipated that readers will come to understand over these pages what the passengers in Lisbon most value and it is possible to meet their needs while ensuring both economic growth and operational stability.

Keywords: Congestion, Mass Transit, Transport, Transportation, Commute, Bus, Public Transportation, Rail, Safety, Subway, Traffic, Traffic Engineering, Travel Demand, Travel Behavior, Travel Time.

JEL Classification: L910, R410.

Resumo

Com a proliferação de cidades cada vez mais urbanizadas, os transportes públicos têm vindo a representar um papel fundamental, enfrentando os muitos desafios trazidos pela sobrepopulação e pela poluição. Para fazer face a estes desafios, serviços de transportes públicos em todo o mundo aderiram à tendência de desenvolvimento tecnológico, introduzindo sistemas inteligentes, sustentáveis e mais eficientes. A constatação de que em Lisboa a mais de metade das pessoas recorre a um veículo pessoal para se deslocar, enquanto que em Copenhaga menos de um terço dos cidadãos o faz, leva-nos a questionar se os serviços da cidade estão a ser prestados da forma mais adequada aos passageiros. Esta dissertação tem como objetivo descodificar se os transportes públicos em Lisboa estão a funcionar em pleno e identificar eventuais lacunas do serviço que possam ser colmatadas com a inserção das mesmas políticas existentes em serviços superiores. Como os tempos modernos são marcados por constantes melhorias tecnológicas, revolucionando e redefinindo as normas de ontem, os transportes públicos em Lisboa devem considerar a adoção de formas inteligentes de operar, e nivelar a qualidade do serviço prestado aos seus passageiros. Espera-se que, ao longo destas páginas, os leitores venham a compreender o que os passageiros de Lisboa mais valorizam, e que pode ser possível satisfazer as suas necessidades, assegurando simultaneamente o crescimento económico e a sustentabilidade da entidade operacional.

Palavras-chave: Congestionamento, Transporte em Massa, Transporte, Deslocação, Autocarro, Transporte Público, Caminho de ferro, Segurança, Metro, Tráfego, Engenharia de Tráfego, Procura de Viagem, Comportamento em Viagem, Tempo de Viagem.

Classificação JEL: L910, R410.

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1. Introduction

Public Transportation services are mass transit systems created to provide a typically assessable and economical way of transportation. Created to provide individuals and communities with the possibility to move to a desired destination without owning any type of personal vehicle, it is a solution to some of the problems of the modern times. For instance, people who are unable to drive, such as the elderly, young, or disabled, or people who cannot afford to own a private vehicle, may travel using public transit services (Welch & Mishra, 2013). Public transportation is also in line with initiatives aimed at making cities more sustainable, reducing environmental dangers and traffic congestion (Eboli & Mazzulla, 2015). There are also financial and administration gains, as these transport modes provide cities with the ability to prevent the need of building and reshaping roads, and with the capacity for policymakers, city planners, innovators, to optimize of the city's area with a simplified and efficient design that pleases every citizen (Lu, 2020).

An alarming call from most cities around the globe raises the need of public transportation to perform well, as the increase of population translates into increased traffic and pollution. People are coming in increasing numbers from rural areas to cities, and the distance between residential areas and functional destinations has become greater, leading to a growing dependence on motorized transports. Consequently, traffic jams are now the norm in many cities, impacting urban life through negative externalities such as air pollution, noise pollution, and high stress levels (Santos & Lima, 2021). Fortunately, patterns on consumer behaviour are changing towards sustainability, and the integration of technology in public transportation has provided services with reliable and sustainable solutions for both operational entities and the passengers.

Present times are defined by globalization, with the spread and interdependence of information, goods, investment, technology. Today, the successes of one can more easily be adopted by another that intents to also improve in anything, and due to it, services can implement measures and live by a model of constant improvement and adaptation for the benefit of its stakeholders. Public transport defines the essence of city lives, and with the ability of information sharing and global cooperations, cities get to learn with the successes of other services (*Mobility Facts and Figures*, n.d.), adopting what is best for the future of its citizens. Although there are still economic, cultural, environmental, and geographical conditions that define each metropolis, some cities work as role models, providing adaptable solutions for common constraints (Lu, 2020). With focus on defining improvements for the passenger experience in the city of Lisbon, this dissertation will analyse what is being practiced around the world and formulate intense research to conclude the existence of potential measures that can become solutions for some of this services' biggest challenges.

Improving the public transport service means improving the experience of the passengers that everyday commute in it and the operators that maintain and guarantee its existence. To develop improvements in the service is therefore to also investigate the characteristics of the elements involved. The comprehension of people's needs will be in the core of this research, and the documentation of the aspects that influence satisfaction and service quality (Allen et al., 2019) will define the structure and availability of usage of foreign implementations.

1.1 Thesis Objective

This dissertation aims to answer the needs of the passengers commuting by bus and metro transports in the public transportation service of Lisbon. As services must manage how to perform under the existence of scarce resources, (Samuelson & Nordhaus, n.d.) the definition of solutions for answering passenger's demands in terms of satisfaction, will be defined by a prioritization model. The aspects limiting passenger experience will be evaluated through a series of tests to find which must be considered firstly for improvement. While doing so, implementations found to successfully improve passenger experience in other metropolises around the world will be compiled, and its correlation towards Lisbon's passengers needs tested. The expected output on processing this research will be to answer to the aspects of Lisbon's service in need of improvement, with benefit-proven measures being practiced in other parts of the world.

1.2 Thesis methodology

The achievement of this dissertation's objective will be conceived by the development of two online surveys, being the first directed to passengers, and the second to people who work in public transports. The subsequent analysis will be performed through Exploratory Factor Analysis, Cluster Analysis, and Importance-Performance Analysis, using as tools for sample testing, the software SPSS 26 and Excel Office 365.

1.3 Thesis structure

This thesis is compiled by another six chapters following this introductory act. In chapter 2 it provided the literature which presents all fundamental knowledge for the purposes of this study. Chapter 3 elucidates how to perform the purpose of the study. In chapter 4 it can be reviewed the results obtained from the analysis previously performed. Chapter 5 compiles the main discoveries of this dissertation. Chapter 6 is dedicated to the exposure of methods that could have been performed differently and might have limited the collection of more accurate results. Chapter 7 aims to present suggestions for the development of future similar studies.

2. Literature review

2.1 Service Quality and Satisfaction

As one of the best definitions of economy fairly puts it, economics is the study of how societies use scarce resources to produce valuable goods and services and distribute them among different individuals (Samuelson & Nordhaus, n.d.). Under this reality, when working on ways to improve the performance of a service, there's the necessity of choosing the optimal attributes to improve. Spending wisely to improve service comes from continuous learning about the expectations and perceptions of customers and noncustomers (Berry & Zeithaml, n.d.).

Evaluating service quality can be defined as the analysis of the gap between what the service provides and what are the customer's expectations (Parasuraman et al., 1985). Higher closure between these two variables demonstrates high patterns of quality on the service (Lai & Chen, 2011). What defines service quality is significantly associated with commuters' satisfaction with the service, positive word-of-mouth, and riders' retention. For guaranteeing quality of service in public transportation, service providers must address the dilemma on how to allocate resources to stimulate rider satisfaction (Tuan et al., 2022). The direct link between service quality as an influencer of customer satisfaction and loyalty retention, leads to the conclusion that providing a better service reflects in an increase in public transport usage (Minser & Webb, 2010), (Lierop & El-Geneidy, 2016). Service quality can be measured by the evaluation of the users perceived performance (Cronin & Taylor, n.d.).

Satisfaction can be defined as the consumer's fulfilment response. The judgment upon how a product or service provided a pleasurable level of consumption-related fulfilment. In terms of the comprehension of consumer satisfaction there is the conception of the complete consumer experience. This englobes satisfaction judgment with events occurring during consumption, such as waiting in the station, seating comfort, noise or smell, and satisfaction of outcomes, a collective impression of the experienced events, through enjoyment, entertainment, or other emotional involvements (Oliver & Richard L, n.d.).

The improvement on Public Transportation must be approached by first understanding the user's perception of service quality, and the method for doing it, is by evaluating their satisfaction, finding the specific attributes on which passengers feel more dissatisfied. Providing solutions to eliminate the dissatisfaction elements of the service will increase customer satisfaction and their willingness to use the service more often (Zhang et al., 2022). Improving the quality of public transportation services can be costly, and making changes unreasonably, can represent shifting costs through higher prices, which negatively affects any benefit previously created (Lai & Chen, 2011). To conveniently analyse the most

appropriate ways to improve the Public Transportation in Lisbon, it is therefore proposed an evaluation of the passengers' perception of the service quality, by analysing their levels of satisfaction if the several dimensions of the service. Most of satisfaction research has been conducted following a traditional analysis. The first step of this formal approach comprises the compilation of key product or service features, expected to englobe all satisfaction or dissatisfaction generating factors. These features are afterwards presented to a sample of consumers, with expectations to fairly represent the total population of interest. Each consumer is requested to firstly evaluate the importance of those features regarding the product or service and afterwards to retrospectively evaluate the product or service on the degree to which each feature was delivered (Oliver & Richard L, n.d.).

2.2 Importance-Performance Analysis application

The IPA technique is a diagnostic decision tool that facilitates the identification of improvement prioritisation, the mobilisation and deployment of scarce resources to where they are needed the most, and the harmonisation of strategic planning efforts to enhance relative competitiveness (Martilla & James, 1977). It has been used in various fields, from tourism, education, food services, to public administration, automotive industry, and public transportation. Its simplicity to be developed and interpreted justifies its popularity among researchers, but the traditional approach of this method of analysis has become too archaic and been accused of representing reliability and validity issues, (Azzopardi & Nash, 2013; Lai & Hitchcock, 2015; Oh, 2001) therefore the development of validity tests is mandatory for successful research on service quality (Esmailpour et al., 2020). As performance is the quantification of the service quality (Cronin & Taylor, n.d.), defining how to measure importance becomes the major challenge. Desirability bias on the measurement of importance has been acknowledged to result into results being tendentially high, (Sever, 2015), a phenomenon also called by "ceiling effect", (Oh, 2001) which is an aspect that must be taken into consideration during the discussion of results. Indirect measurements have been proposed, using performance results (Azzopardi & Nash, 2013), although researchers acknowledge the scale-based approach more reliable than a coefficient-based one (Bacon, 2003).

2.3 The four dimensions of Public Transportation

Defining what features or attributes to use is a crucial moment in these research papers and investigators favour previous successful publications within the same field of analysis as a way of securing relevant conclusions with a future purpose. Many studies have been developed to analyse and understand public transport satisfaction. Despite not all authors following the same attributes, it

is possible to see a pattern where authors frequently name service quality attributes within four components: Reliability, Safety and Security, Comfort, Service (Kaiser, n.d.). As reviewed previously in research for understanding public transport satisfaction (Allen et al., 2019), there will be considered the following hypothesis, H1: Reliability attributes are positively related to satisfaction of public bus transport service, H2: Security and Safety attributes are positively related to satisfaction of public bus transport service, H3: Comfort attributes are positively related to satisfaction of public bus transport service, H4: Service attributes are positively related to satisfaction of public bus transport service.

2.4 Identification of the attributes influencing Passenger Satisfaction

The representation of which attributes represent each of the components is subjective. Despite the fact some attributes are more frequently identified as more important there is no universal agreement between studies when it comes to identifying which attributes have the most influence on satisfaction (Oña, 2020). Lai and Hitchcock mentioned that researchers should focus on the theoretical value of using a new set of attributes and thus a comprehensive literature review to justify the theoretical values of the new set of attributes is essential. As during the validity tests there is likeliness in having to eliminate attributes, to guarantee the maintenance of the whole scope of the service, it is wise to comprise several well-grounded attributes for each of the four components. The chosen attributes for the study of technologies that may improve the customer experience in Lisbon's public transport, are only the ones that, in previous research papers, shared the same component. Therefore, trusting one component of the service on attributes such as *Ticket Fare,* that in each paper represents a different component, shall be avoided (Lai & Hitchcock, 2015). This was done to decrease the ambiguity of cases where attributes are seen to easily influence more than one dimension (Oliver & Richard L, n.d.).

A hierarchy of needs in public transportation was developed, scaling four components in order of prioritization. Reliability is defined as the primary set of needs to be satisfied, and only after a service manages to perform well regarding this component in the perspective of the passenger, other components can the considered priorities. As the passenger gets satisfied in one component, the importance given to it will decrease, switching to the next component. The performance levels on the attributes for those components shall be maintained as they are providing a good level of service quality (performance). The prioritization of the components is defined as guaranteeing firstly Reliability, then Safety and Security, Comfort, and finally Service (Allen et al., 2019).

Ingvardson & Nielsen, 2019, was published to contribute for the better understanding of what the motivators for travel satisfaction and public transport attractiveness might be. The research was performed under the analysis of six European cities, and shared results which allowed us to understand

that measures such as travel speed, ease of access, service frequency and reasonable price should be prioritized on designing a public transport service and adds a correlation between public transport attractiveness and the importance of focusing on public transport as being environmentally sustainable.

Data retrieved from the city of Tehran, concluded as primary necessity to improve service quality, improving comfort related attributes, such as cleanliness of the transports (Esmailpour et al., 2020). With a similar methodology that will be practiced in this study, the study of Tehran's bus service took into consideration some of the attributes to be further analysed, frequency, punctuality, easiness of mobility in the stations, accessibility measures for elder people and people with physical or mental debilitations, security in the stations, security in the transports and comfortable and clean environment of transport and station (Esmailpour et al., 2020). A second paper, also from the city of Tehran, brought more recent conclusions due to new concerns after the COVID-19 epidemic. It was found that the levels of importance on attributes associated with time, ticketing, and safety, decrease for compensation of attributes associated with cleanliness, congestion, and temperature, suggesting new implementations more directed with transport frequency, air conditioning improvement, regular cleaning of the service. This paper brings a good overview of how inconclusive the future can be as the passenger's perception of service quality can variate.

In a study with data sampled from the city of Chicago, expressed a correlation between service quality and customer satisfaction, with problem experience, public image, and customer loyalty (Minser & Webb, 2010). The study suggested a preconceived notion from passengers to be affecting the outcome measures of customer satisfaction and service quality and raises concerns on the influence of negative media and poor agency communication with customers. It also challenges the performance of customer service departments, and the behavior of the operators, evidencing the strong negative effect of a passenger experiencing a problem on the service, in the service quality, customer loyalty and agency public image. The analysis of the agency public image was again addressed to evidence that the perceived quality and perceived value of the company from the passengers influence passenger satisfaction in (Ni et al., 2020). This research assumed corporate image as the antecedent variable, passenger satisfaction as the outcome variable, and both perceived quality and perceived value as intermediary variables. To note that perceived quality refers to the evaluation of the entire service process based on the detailed comparison between the acceptable and expected service, while perceived value is a trade-off between costs and benefits, coming down to the price that the public is willing to pay for a good or service. With its dataset from the tourist city of Hangzhou, China, interesting findings led to conclude that the corporate image has more influence in the

attributes, safety, convenience, and reliability, being these described as practical attributes, and less in experienced feelings attributes, such as the ones within the scope of comfort.

It has also been assessed that the income level of passengers influences the choice in using public transports. People with higher income are less likely to use public transportation because they have the choice to turn into other transportation options. Even if more affordable, they refuse if public transports don't qualify to their expectations of travelling. Ultimately, the only way to attract non-captive users in using public transportation is by guaranteeing good results in all components of the service (Suman et al., 2017).

From the compilation and review of more than 140 studies on public transport satisfaction, in the METPEX project (MEasurement Tool to determine the quality of the Passenger EXperience), it was evidenced that there are salient characteristics of different traveller groups, being that the social-demographic characterisation of the population will heavily condition the prioritization of service improvements and focus (Diana et al., 2016). The dataset of a pilot study to analyse customer experience throughout the EU, documented results from eight cities across Europe. It was concluded that the key attributes for improvement in most traveller groups are the ease of transfer, the station environment, and the onboard comfort. Also, when passengers are not captive to use a transport mode and do it by choice, the level of satisfaction is reported higher. On the other hand, the more repetitively a passenger travels in a transport mode, the lower the level of satisfaction. It is also important to know that in multimodal travelling, the satisfaction with previous transport trip experience will affect the current transport's satisfaction (Zhao et al., 2022), which indicates that a harmonious intersystem is essential for the individual quality of public transportation services.

Interesting findings on travel satisfaction demonstrated that service quality attributes interplay and jointly contribute to a high overall satisfaction, being that it is possible to compensate low levels of satisfaction on reliability and comfort, through registering high levels of security/safety and service (Sukhov et al., 2021)This research paper was performed under the utilization of the attributes, coordination between transport modes, crowding, lighting in stops and stations, comfort and clean environment in stops and stations, off-site customer support, information availability in digital platforms, information availability in stops and stations.

While addressing a comparison study regarding the limitations of the methods Importance-Performance Analysis (Martilla et al., 1977) and 3-factor Theory Analysis (Arabzad et al., 2012), a study with data from a city in Vietnam pointed most attributes' dimensions to be Performance factors, with exception to environmental attributes, which are considered excitement attributes. Performance attributes reflect on dissatisfaction if they are not delivered to the passenger, as reflect on satisfaction

if they do. Excitement attributes don't generate dissatisfaction to the passenger with its inexistence, but they generate delight, and lead to satisfaction if delivered (Tuan et al., 2022).

More previous studies (Oña et al., 2021; Lai & Chen, 2011), defined that strengthening the perception of service quality and enhancing the perceived value are ways to improve satisfaction with public transportation. Security and Safety is the component with the highest impact in perceived value, having ultimately indirect effect on passenger satisfaction. Perceived quality is affected more to less intensively, in the order of the following dimensions, comfort, service, safety, reliability. This indicates that the passengers have high expectations for the travel environment. As previously mentioned, improvements in perceived quality have a direct positive influence in passenger satisfaction. A good explanation for this conclusion is that the relevant preferential policies such as reliability, are more in accordance with the passengers' expectations, like buses running in a punctual manner. Under this scenario, people expect improvements in the travel experience, hereby comfort. Although having the most direct influence in passenger satisfaction, comfort has the least influence in perceived value, because it is understood that for the passenger, arriving the destination is still the main goal (Lai & Chen, 2011; Ni et al., 2020; Sezhian et al., 2014).

An enlightening research paper demonstrated the urgency of guaranteeing a satisfactory level of service quality in public transportation, independently of the stage of development of a country. It is defended that the high-occupancy vehicles are essential to prevent traffic congestion, time wastage and accidents, and while developed countries focused on delivering a service on-schedule and built with consideration of passengers' safety, developing countries didn't, which resulted in public transportation having lost its attractiveness. The results show a decrease on public transportation in developing countries while it has stabilized in developed ones. An interesting insight is that when doing an analysis of passenger satisfaction in a developing country like Ghana, the most significant dimensions of the service are reliability and security (Atombo & Wemegah, 2021).

The service provided in the city of Stockholm, Sweden, served as fundament to provide insights over passenger satisfaction on conditions of a developed country. Findings reference the negative influence on satisfaction mostly due to a low performance of the crowding attribute, which also becomes the most important one for Sweden's passengers. That importance although is shifted to reliability attributes if crowding reflects to not being a concern anymore. These attributes were labelled as performance attributes. Information-related attributes however were found to be excitement attributes, defending that information doesn't really generate dissatisfaction, but provides increased satisfaction upon its existence (Börjesson & Rubensson, 2019). Furthermore, another commitment of public transportation for the future must be the implementation of green public

transports (Lu, 2020), an essential approach alongside the development of eco-city, new urbanization, and lifestyle (Oña et al., 2021). Through data from Lisbon's public transportation service, it has also been proven that giving attention to sustainability is not overlooked by passengers, as it has a direct and positive effect on passenger loyalty and passenger satisfaction (Vicente & Reis, 2018). Sustainability and governance issues are also factors to quantified in the equation of comprehending influencing factors on public transports' service quality (Daimi & Rebai, 2023). In table 2.1 there is a first approach on the organization of the attributes into the four different component's Reliability, Safety and Security, Comfort and Services.

Table 2.1 Components and attributes explored in literature

Dimension	Attribute	Authors
Reliability, Functionality	Frequency	Ingvardson et al. 2019, Esmailpour et al., 2020, Esmailpour et al., 2022, Allen et al., 2019
Reliability, Functionality	Speed	Allen et al., 2019; Esmailpour et al., 2022; Ingvardson & Nielsen, 2019
Reliability, Functionality	Punctuality	Allen et al., 2019; Esmailpour et al., 2020; Ingvardson & Nielsen, 2019; Minser & Webb, 2010)
Reliability, Functionality	Easiness of mobility in the stations	Alhassan et al., 2022, Esmailpour et al., 2020, Esmailpour et al., 2022
Reliability, Functionality	Accessibility measures for elder people and people with physical or mental debilitations.	Daimi & Rebai, 2023, Esmailpour et al., 2020
Reliability, Functionality	Easiness entering and leaving the transport	Ona, 2021, Allen et al., 2019, Ingvardson et al. 2019
Reliability, Functionality	Coordination between transport modes	Ingvardson et al. 2019, Allen et al. 2019, Susilo & Cats 2014, Sukhov et al., 2021
Safety, Security	Security in the stations and stops' surroundings	Allen et al., 2019, Minser & Webb, 2010, Suman et al., 2017
Safety, Security	Security in the station	Esmailpour et al., 2020, Esmailpour et al., 2022, Susilo & Cats 2014, Minser & Webb, 2010, Ingvardson et al. 2019,
Safety, Security	Security in the transport	Ingvardson et al. 2019, Esmailpour et al., 2020, Tuan, 2022
Safety, Security	Driving Skills	Allen et al., 2019; Esmailpour et al., 2022, Mazzulla, Ni et al 2020, Ingvardson et al. 2019
Safety, Security	Transport safety measures	Esmailpour et al., 2022, Ni et al 2020 , Atombo & Wemegah, 2021
Safety, Security	Efficiency of entities over emergency needs	Niet al., 2020, Atombo & Wemegah, 2021
Comfort	Crowding	Esmailpour et al., 2022, Sukhov et al., 2021, Borjesson & Rubensson, 2019, Minser & Webb, 2010
Comfort	Behaviour of operators	Lai & Chen, 2011, Borjesson, 2019, Esmailpour et al., 2020
Comfort	Lightning in stops and stations	Ni et al., 2020, Sukhov et al., 2021

Comfort	Comfortable and clean environment of transport and station	Ingvardson et al., 2019, Allen et al., 2018, Borjesson & Rubensson, 2019, Sukhov et al., 2021,
Comfort	Modernity of transport	Ingvardson et al., 2019, Minser & Webb, 2010
Comfort	Atractive and entretaining stations	Minser & Webb, 2010, Ni et al., 2020, Vetrivelsezhian, 2012
Services	Customer support availability in the stations	Ingvardson et al., 2019, Borjesson & Rubensson, 2019, Ni et al., 2020
Services	Easiness to purchase tickets	Allen et al., 2019, Ni et al., 2020, Lai & Chen, 2011
Services	Fare evasion	Atombo & Dzigbordi Wemegah, 2021, Vicente 2020
Services	Online Cutomer support availability	Lai & Chen, 2011, Sukhov et al., 2021, Allen et al., 2019
Services	Information availability in digital platforms	Allen et al. 2019, Ingvardson et al., 2019, Sukhov et al., 2021
Services	Information availability on board	Ni et al 2020, Vu Anh Tuan 2022, Esmailpour et al., 2022,
Services	Digital applications' information performance	Ni et al 2020 , Ingvardson et al., 2019, Tuan., 2022
Services	Information availability in stops and stations	Ingvardson et al., 2019 Esmailpour et al., 2022, Sukhov et al., 2021, Tuan., 2022

2.5 Inclusion of new technologies in public transport

A second stage of this research is to identify technological measures with potential on having a positive effect in passenger satisfaction, to the service qualities' attributes defined in the state of art. The important aspect about reviewing previous research about the measures that can be implemented, comes because without the evidence of prior successful implementations, the intended solutions become unmeasurable. Implementations with undocumented results, can't be analysed prior to their implementation, making them an unnecessary risk to take. In this case, it is rather assertive to preview what innovations have been implemented in global metropolises and comment on how they improved the experience of the passengers of their transports' networks. The research papers collected will contribute with potential implementations to be made in four main aspects of the service, the ticketing, the automation, the display and projection, the digitalization.

2.5.1 Ticketing Innovation

The Ticket Innovation defines the potential changes on the current ticket purchasing and validation options offered by the operators of the public transport service in Lisbon. Among the measures to be potentially introduced in the Lisbon bus and metro services, there is the introduction of a more complete ticketing system. Previous research has demonstrated how the concept of customer

experience can be translated to the concept of ticketing experience (Zalar et al., 2018). In a research paper presenting results from residents in Sydney, Australia, it was concluded that the variety of ticketing options and simplifying ticket purchasing has been described as part of a package of policy measures designed to increase public transport usage, consequently contributing for a decrease of usage of personal vehicles, even among higher income groups of passengers (Ellison et al., 2017). The adoption of smartcard ticketing systems has removed the need to physically buy a ticket and makes boarding easier for passengers. The benefits for the passenger are evident, as data from London shows an increase of boarding rates by four times, while Queensland has reported a cut on boarding times from eleven seconds to only three. The introduction of the smartcard to promote ticketing simplification has been reported to positively influence passenger satisfaction (On the move 2009 activity report, ON, n.d.). For the operation, it translates into less delays to services and a potential increase of service frequency (Ellison et al., 2017). Additionally, there is evidence that through time, automatic card readers express substantially less maintenance costs than ticketing-printing machine systems (Pelletier et al., 2011). Another benefit for the operation is the allowance of creation of key performance indicators through the collection of customers' travel data (Munizaga et al., 2014), and in the prevention of fare evasion due to the link of the cards to individual information (*TTF-The-Benefits-Of-Public-Transport-2010*, n.d.). The most felt limitations of smartcards are the inevitable issue regarding privacy, due to the collection of details travelling information, costs on implementation can also express concerns for the operation entities (Ellison et al., 2017).

The previously analysed seamless ticketing approach is made possible through an arrangement by the service providers, making multimodal public transportation services accessible to users by allowing them to use the same ticket on every part of the journey. More advantages follow as it eliminates the need for users to go through inspection of their tickets in all trips, a requirement that invests time and effort into direct interactions with ticket inspection staff. It also allows the removal of the barrier effects of turnstiles (Alhassan et al., 2022). Research on the optimal inspection level (Barabino & Salis, 2019) suggested that checking between 34 and 40 out every 1000 passengers is the optimal inspection level for public transport service providers to maximize profit given the presence of fare evasion. This means that seamless ticketing allows most passengers to not having to face the inconveniences of ticket payment and inspection during their journey, making public transportation more assessable. Accessibility influences passenger satisfaction, which reflects that an improvement in accessibility has a positive impact in the passenger satisfaction (Atombo & Wemegah, 2021). Furthermore, (Alhassan et al., 2022) demonstrated that passengers prefer the seamless ticketing approach in comparison to any other ticketing method of purchasing and validation. The willingness to start using new technological solutions in ticketing has been verified, especially in younger groups of the population

(Rosa, 2022). There is also literature that indicates that an even more convenient ticketing model is by using smartphones to buy and validate tickets, providing an even better, more seamless travel experience (Zalar et al., 2018). The Copenhagen public transport service, through the application DOT, is an example of mobile seamless ticketing.

Automatic fare collection systems are a technological implementation that allows observing how people move through the city, create travel patterns and time use analyses, without the need of research based on surveys, that are complex, sample-size limiting and don't provide precise time and location variables. It is possible to analyse the behaviour of the population per zone of the city and therefore optimize demand time, to better satisfy the needs and frequency of the transport (Amaya et al., 2018).

2.5.2 Automation of Public Transportation

From fully automated trains to smart stations, automated metro systems have received increased attention for many years, and with the fast-paced development of technology towards autonomous cars, the same is starting to be felt for the bus public services. With respect to the metro services, the implementation of an automated train operation goes back since 1981, in Kobe, Japan, and the international adoption is clear, in the space of two years, from 2018 to 2020, the length of automated lines worldwide increased 24%, from 1026 Km to 1350 Km. As of 2020 more than a quarter of the world already had at least one automated line in their metro service, accounting for 8% of the total infrastructure worldwide (Brownfield metro automation considerations for GOA4, GOA3 and GOA2 upgrade projects, U.I.T.P, n.d.). Data respecting to the insertion of this system on rail transports has been analysed over many research papers, evidencing benefits towards public transportation.

In terms of its influence on reliability, fully automated operations record optimized and consistent dwell time, optimization in speed curves and turn-backs, and a consequent reduced waiting time and increase on capacity (Harms & Fredén, n.d.; Rosberg & Thorslund, 2020). Automated metro lines also minimize operational disruption, due to technology redundancy and reliability. Forces improved maintenance due to the impossibility for the system to work with minor errors like with conventional metro system. Prevents customer-related disruptions due to the Platform Screen Doors. Provides a wider array of options in case of service disruptions such as automated train rescue. Enables automatic coupling and uncoupling of the train, shortening rescue time in case of disruption. Allows with flexibility for peak hours, optimizing the service over demand and facilitating a 24/7 operation, and minimizing costs with reduced operation off-peak hours. Enables itinerary adaptability and train

size adaptability, by skipping stations and decrease shuttles, conveniently allocating capacity to meet customer's needs while optimizing fleet and reducing headway (Knowledge brief, U.I.T.P, n.d.).

For passengers, fully automated lines improved customer service, which caused a positive effect in passenger satisfaction. There are many implications brought by the automation of the service in the quality of customer service. Primarily, the cabin staff has been relocated to be closer to the passengers and assisting them, this way at equal staffing levels, the operation is more efficient in providing customer support and intervening in other issues. More visible presence of staff also enhances the feeling of security among passengers and the operation can be more efficient in cases of emergence. As for operators, the benefits are also felt. From operators that experienced both conventional and automated system, the rates of fulfilment and commitment to the job has increased with automation, being that a broader set of responsibilities and dynamic workplace seems to improve work conditions. Also, multitasking demands multi-skilled staff, with a customer-oriented mindset, which means that jobs require more qualification and internal training, resulting in profiles with potential to evolve within the organization (Knowledge brief, U.I.T.P, n.d.).

Regarding safety, automated metro operation holds the safety record of no fatalities for over the 35 years of implementation. Conventional metro systems conceive risks linked to human error that don't exist in automated systems, and results show that critical traffic accidents are largely caused by the drivers (Highway Traffic Safety Administration, NMVCCS, 2008). Trips are smoother due to the optimization of acceleration and braking systems (Rosberg & Thorslund, 2020), reducing passenger injuries, and increasing comfort. Connected with the improvements in customer service, the perception of both safety and security have also increased due to a better monitoring service and more direct communication channels between the passengers and the operation entity. Automated systems have track intrusion protection, through platform screen doors, chosen in 87% of the automated lines implemented, including Paris, Hong Kong, and London. There are also obstacle detection systems, which stop trains immediately in case of any intrusion in the line. Platform screen doors are considered the best protection measure, because eliminates the chances of intrusions preventing them. While having its primary objective to prevent accidents acting as a physical barrier, it also improves the operational efficiency, with a more controlled passenger flow. Having designated entry and exit points, it reduces congestion on the platform, especially during peak hours, ensuring a more orderly and efficient movement of passengers. This system tends to increase the passengers' experience and confidence on using the metro, enhancing the reputation of the transport mode (Platform screen doors to, 2010s). Often implemented alongside with the automated of the lines, due to economies of scale that lower their CAPEX, platform screen doors' results have justified previous implementations even on conventional metro systems (Knowledge brief, U.I.T.P, n.d.).

In terms of affordability, the CAPEX can be reduced by properly managing the higher capacity of the automated system, as it allows the usage of smaller trains and creation or adaptation to smaller stations and platforms. It also minimises the need of fleet reserve for maintenance, which normally rangers 15% of the entire fleet. A fully automated signalling system is still more expensive than a conventional one, although automated trains have become economically more viable. The implementation of platform screen doors gets to be the main added cost but is as seen before to be one of the most attractive implementations to be made for all public transport shareholders. The greater benefit is explained by the OPEX, showing that current automated practices save up from 15% to 30% more costs in comparison to the equivalent conventional line. The increased revenue comes from the combination of the previously mentioned reliability factors, that report a decrease of the overall car Km costs by 25% to 35%, and other factors such as, energy saving, reaching up to 15% in comparison to conventional lines, and more efficient organization, elimination of driver costs and allocation of funds in customer care positions. Regarding maintenance costs, there will be increases in costs related to the higher technical qualification of new employees or current ones, and in extra maintenance on the implemented platform screen doors. On the other hand, automated lines are equipped with better diagnostic means, facilitating maintenance, allow the disposal of several materials and equipment for the conventional tracks (Griffe, 1997; Knowledge brief, U.I.T.P, n.d.; Yin et al., 2017). As previously evidenced, automated systems reduce the overall power consumption of the system thanks to the optimization of the fleet sizing and operations. The reduction of energy consumption to 15% can even be increased to 30% when systems operate with train coupling.

To implement a metro automation project, it is important to consider a multitude of factors to ensure that the investment is justified at the present time. This decision is usually taken in strategic moments, when there is the chance of practicing economies of scale. A first scenario is when full capacity is reached, as already evidenced to improve capacity, the automation of the line is also generally less expensive than expanding the infrastructure. It can also coincide with major system renewals of subsystems. May also be considered in case of difficulties hiring drivers, or for reaching climate impact goals (Brownfield metro automation considerations for GOA4, GOA3 and GOA2 upgrade projects, U.I.T.P, n.d.) interoperability, or to improve safety (Goverde et al., 2013; Rosberg & Thorslund, 2020).

When it comes to the automation of the bus system, the scenario is more challenging, as there are no cases of impacting influence of automated bus systems in cities yet, and the scientific evidence is less that for rail line systems. Nevertheless, many research papers support the future of road vehicles to be in automation and driverless models, as many companies already invested heavily in becoming pioneers in this new technological change (Zhao et al., 2022). As means of fact, the UK government is

encouraging the development of automated vehicles technology (Cyber security over automation, 2020). Several are the benefits pursued in literature regarding automated buses. To Facilitate the reduction of energy costs, improve safety by reducing and mitigating traffic accidents. Also, to provide opportunities to reduce transportation energy consumption and emissions by improving traffic flow. Vehicle communication with traffic structures and traffic lights can allow individual vehicles to optimize their operation and account for unpredictable changes (Rios-Torres & Malikopoulos, 2017), improve fuel economy (Vahidi & Sciarretta, 2018), time savings from decreased congestion and added productivity from the hands-free driving environment, promote economic growth (Clements & Kockelman, 2017), increase accident prevention (Ye & Yamamoto, 2019), alleviate traffic congestion and improvement in travel behaviour (Talebpour & Mahmassani, 2016), beneficial impact on public health and wellbeing, increased travel equality and accessibility for all (Goggin, 2019). Results over a potential development of automated bus systems, expressed positive results, on which people will most likely accept the evolution of the bus network by the implementation of automated bus service (Bernhard et al., 2020a) after experimenting this type of transportation once, most people demonstrated agreeability upon the good safety levels of the transport, most described a non-necessity for an operator on board, rated a comfortable braking system, with few limitations considered involving speed or travel boredom, factors that can be improved with the development of new prototypes (Bernhard et al., 2020b). More studies fall into the same positive conclusion (Christie et al., 2016)(Nordhoff et al., 2018). On a more profound study over the evolution of acceptance of people regarding automated buses, it has been concluded that in Sweden, where is has been deployed the automated bus system in small routes, over time, the evolution of satisfaction upon the service changes, the biggest threats for the service currently tend to be the comfort needing to reach an equal level as to the normal buses, and an increase the frequency of the service (Zhao et al., 2022).

2.5.3 Digitalization for Public Transportation

Cities worldwide have embraced digital navigation systems to support passengers in their journeys. Time-saving skills linked passengers with the need for information (Velazquez et al., 2018), and with the appearance of more users, service information has improved, bettering real-time updates of the transport, providing accurate route choices, tracking multi-modality (Berger & Platzer, 2015). Besides capacity for improvement by allowing the coverage of passenger's travel experiences, applications have created a stream for collaborative knowledge, greatly contributing to planning processes that allow users become part of the improvement process, by providing real-time information and feedback as well as detecting gaps in the service (Sarker et al., 2019). Passenger satisfaction also improves passenger experience through traveller engagement, with acquaintance to more enjoyment, user

empowerment and self-actualization (Sun et al., 2017). Indeed, through social applications, there is potential to produce a more effective network of communication with passengers, and improve travel experience (Sarker et al., 2019).

Moovit is an example of a MaaS channel in several parts of the world, it is a third-party developer providing free public transportation information. This navigation application uses both passive crowdsourcing data to improve transit route schedule and active crowdsourcing via user reports of incidents and vehicle crowding (Heiskala et al., 2016). It is today the largest repository of transit data, and its collaboration with the operating entities, aiming the improvement of passenger experience, has become a necessity for the future. Consequently, user-based information is now an integral part of designing and operating a high-quality transit system. More than ever, operators need to promote a routine among passengers of information sharing and the sense of being part of a community, as it ultimately works with better results for the full comprehension of passenger travel experience and further reflection of potential improvements (Dickinson et al., 2015). To achieve more user engagement, it has been studied that developers shouldn't rely on monetary incentives for long run results, but by satisfying the needs of social recognition and user appreciation. It was found that applications should take into consideration the providence of recognition features such as tokens for social responsiveness, like it is practiced in the multi-modal application for Copenhagen. This type of engagement, also known as gamification, encourages users to the collaborative and promote information sharing (Dastjerdi et al., 2019).

From the features passengers more look into in MaaS channels, research evidences a prioritization of access to real-time information and dynamic updates as the most important feature, being followed by special services for increased safety and security (Vij et al., 2020).

2.5.4 Projection and Display

The public transportation services of cities around Europe have taken into consideration the waiting time of their passengers in a strategic way. Even by optimizing reliability indicators to a level of great efficiency, it is fair to say that there will still exist the need for passengers to wait a certain amount of time for their next transport and inside the transport until they reach their destination. The waiting time is a permanent liability of the service but can be taken as an opportunity in various ways to positively influence passenger experience while addressing operational demands. The projection of content in stations and inside the different transports has brought a fundamental view on how to use space efficiently, not depending on a substantial investment.

The projection of content comprises the implementation of screens or projectors to present appealing, well designed, and convenient information, may it be related to the service of public transportation, to cultural insights of the city, upcoming events, social awareness, a platform for art or withholding entertainment features. The projected or displayed content can also serve as a navigator assistant inside the stations or be a platform of the city for sensibilization of physio and psychological help. Can also be used with collaboration with local businesses to enrich small commerce. Allows people to feel entertained through trivia questions, cultural facts, news from the city or country scope. The waiting environment can positively or negatively affect passenger satisfaction, with one of the most important contributors to it being the comfort while waiting in stops and stations (Sun et al., 2020). For a positive influence on passengers while waiting in stations, the display of artistic content has been reviewed with positive outcomes. This change in stations can effectively spark an improved sense of comfort (Zhang et al., 2022), as colour influences comfort levels, contributing for a better passenger experience. In what concerns operational inbound, it may become a new stream of revenue where businesses invest on their self-promotion, be used as a tool to spread awareness over convenient topics and promote sustainable behaviour. Brings the possibility to promote the use of public transportation, being a potential channel to increase loyalty over the service. It also allows the development of new streams of information to control the service's performance if the operation choses to incorporate satisfaction feedback. An important aspect within the scope of interest of the operation is its low implementation costs when compared side to side with the previous passenger experience improvement measures that are responsibility of public service entities.

3. Methodology

This chapter is divided by 3 subchapters, the first is to demonstrate how it is intended to document evidence of implementations in public transportation services outside of Portugal. The second defines under which conditions the surveys for professionals and passengers will be held. The third subchapter marks the definition of the required analysis to the enablement of reliable data results. Exploratory Factor Analysis, Cluster Analysis, and Importance-Performance Analysis will be performed.

3.1 Field Research

Research literature enlightened this dissertation with scientific results over the benefits of implementing changes on four areas of the public transportation services. The intention of understanding how specifically these changes were made and perform daily, remained as food for thought and led to the intention of capturing and documenting each in a real transportation environment. The field research stage was therefore planned to be done in the metropolises of Copenhagen, Stockholm, Malmo, Cracow, Barcelona, Paris, and New York. These places were chosen to be visited and their implementations documented, due to having been the data sources to research literature that reported expressive conclusions on how to pursue service quality. Copenhagen has specially been object of several mentioned research papers due to its superior service quality, consequently attracting a high percentage of population to choose public transportation. Stockholm has also been evidenced in research to be implementing automation in buses and, like Krakow, has a very comprehensive digital system that provides accurate information to its passengers. New York has implemented a new application that influences the passengers' perception of Security. Barcelona and Malmo have implemented changes in the environment of their stations, that interestingly might have positive psychological effects in passengers. It is important to underline that all these metropolises' countries have a higher HDI compared to Portugal (HDIR21-22, n.d.). Furthermore, data collected from Statista expresses that the amount invested in millions of euros in public transportation is also significatively higher than the reported by Portugal in the last years, to an extent that the area and demographic variables don't justify the disparities. For instance, Poland invested 2 727 million euros in inland transportation in 2013 while Portugal invested in the same year 282 million euros. Also in the same year, Denmark, having around half the population, invested 996 million euros solely in rail transport infrastructure. The discrepancy on investment is acknowledged as an obstacle for the implementation of technological measures implemented on other metropolises, being that each of the proposed measures will have to be evaluated on feasibility by professional elements of Lisbon's public transports service.

The potential implementations foreseen had the opportunity to be presented to a professional, Coordinator of Metro de Lisboa, and expert in the public transportation in Lisbon. The intention of the meeting with a professional was to measure the adequacy of these implementations from an expert point of view, given the conditions of Lisbon's service. The implementations demonstrated a real potential to be inserted in the public transportation service, not being too challenging financially, when facing the potential return on investment of each and having relatively clear benefits. There were also fruitful outputs from sharing thoughts and opinions regarding the current service, as it was decided to be added two more intentions of development, one for security, the addition of a feature in navigation applications to report suspect or unusual items, another as a counter measure for the potential automation and digitalization of the service, the implementation of a more robust software to prevent the occurrence of cyber-attacks. The summary of the implementations collected will be presented in chapter 4, as of the presentation of results.

As it was firstly introduced in subchapter 2.3, there are several possible changes that were made in other cities with the shared purpose of improving the passenger experience. Changes in the Ticketing System, for optimization of time and creation of a more simplistic and accessible transport. Furthermore, the Automation of the public transports, which has arisen in most European metropolises and seems to have become a trend to be followed by others, also englobes several implementations found to be of interest for further analysis and consideration upon their implementation in Lisbon. A third area of implementations to be considered is Digital Support, as the digitalization phenomena affected the service in many ways and has been vastly explored in some cities rather than in others. Lastly comes another field of insertion of measures, which is the Projection and Display of content. These types of implementations vary according to the city's characteristics and require a good reasoning by the controlling entity.

An interesting aspect that makes the quality of the service analysis through experience more ambiguous and its results fragile is the fact that people might not fully understand what they need before a new feature is implemented. Due to this reality, certain attributes that present better results of satisfaction, could perform poorly, if passengers would experience a different approach of the service (Oliver & Richard L, n.d.). Still, and because it's not possible to make all Lisbon's passengers experience the reality lived in other metropolises' services, this analysis shows the will of the passengers that know the city of Lisbon and is presented as a study for risk management when aiming for successful implementations given Lisbon's conditions. Another aspect worth mentioning is the fact that people must be informed and instructed into using the new implementations. It is hard for people to change habits, even if there is a beneficial measure to be implemented. If this benefit is not clear, the effectiveness and success of this implementation will be questioned. For instance, in Lisbon, most

people still don't use online payment for tickets, when it has been evidenced as the most agile and used way of purchase in other metropolises. This happens due to lack of communication streams between the transportation service and its passengers.

3.2 Data Collection

The collection of data results will be made through survey analysis and is divided in two stages. A first approach is given by exploring to which extent, people that work for the Public Transportation consider beneficial, implementations on the service that are being made on other metropolises. The second stage will collect data from the passengers of Lisbon's Public Transport. On this stage, the answers provided by the passengers will serve for the de achievement of two purposes, the construct of an Importance and Performance analysis over the current service, and the passenger's perspective on how beneficial the potential implementations can be for their passenger experience.

3.2.1 Professionals' view on perceived benefits

Collecting data regarding the perspective of professional elements of the public transportation services, has intentions to both confirm the availability for the implementations to be held in Lisbon, therefore being eligible for further analysis, and to evaluate to which extent the operation is aligned with the passengers, on defining what is more beneficial for the improvement of passenger experience. Comparing both stakeholders will allow this study to potentially find discrepancies on the importance given towards implementations. These dissimilarities between operation and passengers can provide the root causes of limitations towards service quality. Agreeability on both ends over the high importance of an implementation more confidently flags it as a commonly perceived improvement for public transportation. The opposite can also be concluded, as lower importance given from both sides redefines the implementation with incremental risk and ambiguity regarding its success.

The survey targets all Public Transport professionals, not limited solely on the ones operating in Lisbon. The survey will be conducted through the Likert scale method from 1 to 5, considering the grading values from 1 = "None" and 5 = "Extremely". The participation of Portuguese and English-speaking participants will be made possible through the development of two versions of the same survey. The translation of the scales will be made as "Nada" = "None"; "Pouco" = "Low"; "Mais ou menos" = "Medium"; "Bastante" = "Considerably"; "Extremamente" = "Extremely". People working for Lisbon's system have internal knowledge and know better the particularities and challenges of the system. National and international insight from other public transport services also brings added value due to their different approach towards Public Transportation, and familiarity with some of the

implementations that are being proposed. Individual profiling questions will introduce the survey, distinguishing professionals by the years of experience, transport of specialization and area of specialization. The questions that will follow will permit each professional to evaluate the several implementations in the dimensions of passenger experience and operational efficiency. According to the Likert scale agreement statements, the chosen rating will be from 1 to 5. The ratings given express how important the proposed implementation is believed to be for improving the passenger experience, being that ratings of one reflect the opinion of having no positive influence whatsoever in each dimension, and five having extremely positive influence in each dimension. There is enabled the possibility to add comments for further discussion and recommendations.

3.2.2 Survey to passengers' design

This dissertation intends to provide guidelines of prioritization to the development of the Public Transportation in Lisbon, by demonstrating which attributes are influencing more negatively the experience of passengers. The research also embraces a second commitment, to introduce solutions that have been successful in other similar services worldwide, and in an exploratory way, analyses the degree of acceptance towards them that exist from both passengers and collaborators.

To fulfill both intentions, it was designed a survey, specifically intended to comprise people who consider having experience in using the public transportation services, of the Lisbon metropolitan area. The data is set to be collected in the form of categorical dichotomous, categorical nominal, categorical ordinal, and continuous interval variables. The categorical ordinal variables are intended to be assessed in the same way chosen to the survey directed for professionals, through a 5-point Likert scale. The ranking of answering is defined as, "None" to be equivalent to 1, "Low" to be equivalent to 2, "Medium" to be equivalent to 3, "Plenty" to be equivalent to 4, and "Extremely" to be equivalent to 5. The survey is divided in four stages, a segmentation stage, with purpose to filter and direct each person to the most indicated transport and set a loyalty customer profile. The second stage gives respect to the evaluation of the attributes of the service in the levels of performance and importance. The third stage of the survey, similarly to the survey for the professionals, presents technological solutions that have potential to be implemented in Lisbon's service, and proposes the passengers to rank how beneficial they consider each solution to be for their experience as passengers. The fourth and last stage is meant to stratify socio-demographic profiles of the population.

For the analysis of the results to be obtained in the second stage of the survey, evaluation of the attributes, an Importance-Performance analysis will be made (IPA). The Importance-Performance Analysis will be made using a data-centred quadrants approach and flexible data-centred diagonal line

model, as previously proposed (I. K. W. Lai & Hitchcock, 2015) in a framework for researchers who want to guarantee the utility and reliability of their results in similar research papers. For assessing convergent validity, the IPA will be conducted through an Exploratory Factor Analysis, as there is no necessity to develop assumptions about the distribution of the variables. The number of participants is set to be of more than 100 (Hair Jr. et al., 2014). Due to the great diversity in socio-demographic characteristics, and to anticipate non-normality constraints from attributes, this study will also rely on a Cluster Analysis.

3.3 Data Analysis

One limitation of proceeding immediately to the development of the IPA, is that when doing so, the sample collected would be homogenous, not taking into consideration the individual socio-demographic profile and the levels of importance someone reflect in different attributes. Being this the case, it will be further explored how to guarantee the maximum reliability of the results.

3.3.1 Exploratory Factor Analysis

Lai & Hitchcock, 2015 called the necessity of performing a construct validity test in research papers where usually attributes are grouped into dimensions. As public transportation is most often analysed by dimensions of attributes, this dissertation shares the same intention on approaching the analysis of the data obtained from the passengers' survey. As there is a lack of specified constructs regarding the dimensions of the public transportation service, the Exploratory Factor Analysis seems more adequate for the assessment of convergent validity of the IPA. The EFA will be applied on Performance and Importance attributes' data, as they are both being directly measured on this dissertation. Although the results for Performance and Importance differ, with the common tendency of Importance to register higher results, it is expected to be found a similar pattern on the results, as they measure the same set of attributes. In the process of defining the components during the EFA, a Cronbach test will assure the internal consistency of the scale on each component. In this test, the components, or sets of attributes, must demonstrate an alpha coefficient (α) above 0.60 (scale ranging from 0 to 1). The software used for the development of all tests for EFA and Cluster Analysis was SPSS v.26.

To test the necessity of taking homogeneity into account, it is therefore recommended to perform normality tests first. If the results express non-normal distribution, further steps should be considered, such as attributes elimination (if one case of non-normality), bootstrapping, or Cluster Analysis (if several cases are found). To conclude if the distribution of attributes is relatively normal, it will be performed the Kolmogorov-Smirnov test for normality (Ghasemi & Zahediasl, 2012) and

Mardia's multivariate kurtosis (Mardia, n.d.). Kolmogorov-Smirnov indicates non-normality if the values of significance on each attribute are below p-value of 0.05 (p-value<0.05). This test while performed with the collected data for both bus and metro resulted in all attributes for both Performance and Importance to be representative on non-normality (values of 0.00), The K-S test tables are available in Annex A. When processing the test of Skewness and Kurtosis, authors tend to use different z values depending on the size of the sample. For a sample of more than 100 respondents, it is acceptable to use the critical z value of ± 2.58 for the significance level of 0.1, although some authors might prefer to use a wider range of values like z ± 3.29 (Pamela et al., 2020). For this research, the value will be in accordance with Esmailpour (2020), using z ± 2.58. The results showed that several attributes exceed the defined cut-off value for both Skewness and Kurtosis. When analysing the metro sample, two attributes exceeded Skewness and one exceeded Kurtosis on Performance, and on Importance most attributes exceeded both on Skewness and Kurtosis. As for the bus sample, two attributes exceeded on Skewness on Performance while most attributes exceeded on Importance for both Skewness and Kurtosis. See Annex B for Skewness and Kurtosis tests on both transports. This evidences once again the non-normality of the attributes. The recommended approach when many attributes are non-normal is to apply Cluster Analysis (I. K. W. Lai & Hitchcock, 2015).

The continuation of the research will be held by evaluating the results of the Principal Component Analysis with varimax rotation and eigenvalue exceeding 1.0 with factor loadings exceeding 0.25 (I. K. W. Lai & Hitchcock, 2015). The reliability of the data is firstly tested using the Kaiser-Meyer-Olkin test for sample adequacy and the Bartlett's sphericity test. Kaiser-Meyer-Olkin (KMO) results, ranging from 0<1, must present values above 0.7, while the p-value of the Bartlett sphericity test should express a significance of 0. The Principal Component Analysis (PCA) will group the attributes analysed by the similarity, or higher correlation between each other, and the sets of attributes are defined as components. It is accepted for attributes to be considered when having factor loading above 0.50 (scale from 0 to 1), although it is preferred when all components have attributes above 0.60 (Esmailpour et al., 2020). In the scenario where the results from the PCA don't satisfy these recommendations, the lowest factor loading attributes shall be removed (less correlation) and KMO and Bartlett tests must be performed again. This process is repeated until the conditions are all satisfied, where the resulting components will represent the inherent attributes. As previously mentioned, upon the definition of the components, the internal consistency of the scales is then evaluated for each component reaching value $\alpha > 0.60$.

3.3.2 Cluster Analysis

The effect of heterogeneity in the accuracy of the data can be effectively surpassed through clustering the participants into different groups. In this research where there is great diversity of people in socio-demographic levels, this is referred to be the most adequate approach (Esmailpour et al., 2020). By proceeding with a Cluster Analysis, people fall together into the same group with account to their similarities when grading each attribute by performance and importance. The Cluster Analysis clears common assumption concerns on statistic studies such as normality, linearity, and homoscedasticity, but in opposition, it's very impacted by multicollinearity (Hair Jr. et al., 2014). This means that by using all attributes, some will have greater impact on the clustering process. In other analysis this could be harder to evidence but due to the definition of components through the EFA analysis, it can be possible to avoid multicollinearity impact on the cluster formation. The way to do it, will be by using solely the highest factor loading attribute of each component. Due to Varimax rotation, it is known that the extracted factors are independent.

The clustering process will be taken in two stages, through Hierarchical Clustering approach and through the Non-hierarchical K-means approach. The Hierarchical approach is intended to provide with the optimal number of clusters on which people will be divided. The Ward's method with squared Euclidean distance will define the hierarchy and the distance measurement. After finding the optimal number of clusters, using the K-means approach will provide the ultimate distribution of people within the already pre-defined number of clusters. The K-means allows the optimization of the allocation of participants per cluster by redefining the clusters by seeds and re-allocating the participants from their original cluster to a more approximate with its characteristics (Esmailpour et al., 2020).

3.3.3 Importance-Performance Analysis

The method used for the development of the IPA will be, in accordance with the conclusions previously discussed in section 2, the data-centred quadrants approach aligned with the diagonal approach. The first action is to define the performance and importance averages of each attribute. Secondly, it is needed to define the gaps, which are the difference between the performance and importance results (subtracting the performance result by the importance result). The comprehension of the gaps' results will allow the prioritization of budget allocation for improvement of the service, where the smaller the gap, the more prioritized that attribute or component must be. The understanding of this criteria comes to the fact that whenever two attributes have the same performance level, one has a smaller gap because the importance is higher (subtraction method), the same influence exists on the opposite situation, when having two attributes with the same importance, the one with the smaller gap is because the performance is the lowest. Taking into consideration the influence of the diagonal line,

which is y=x, and the definition of gap= 0, it is possible to conclude that whenever an attribute is below the diagonal line, it has a negative gap value, and the further away it is from the diagonal, the more critical for improvements it gets. In opposition to the case, values above the diagonal line need more attention the closest they are to the diagonal. Each component and attribute on the IPA charts will have a Confidence Interval (CI) of 0.10. Special attention will be given to attributes and components on which their mean and limits of confidence Intervals don't match into the same quadrant.

3.3.4 Analysis of most critical attributes and implementations

The final analysis of this dissertation is to review on which extent the attributes that more negatively affect passenger experience and the possible implementations on the service can be connected. The results of the field notes and the literature review of chapter 2 on new public transportation implementations, will provide this study with sufficient input to define implementations for Lisbon's public transportation that have positively affected the different attributes of the public transportation service. For the development of this analysis, these implementations will be ranked by the passengers' perceived value towards the related public transport (bus or metro), and as previously mentioned on section 3.2.2, this represents the results to be provided by the third stage of the survey to passengers. Considering the IPA matrixes' results developed in the Importance-Performance analysis, it will be possible to identify the attributes with the lowest Importance-Performance scores, for each cluster of the sample. These attributes represent where the necessity to implement changes is more aggravated and will therefore be the ones to consider for the rest of the study. Considering that, at this stage of the dissertation, it will be already known which implementations affect positively each of the attributes, there is the possibility to cross-examine for each of these attributes, on each cluster of people, the way the related implementation was ranked. Implementations with a high level of acceptance by the public, that positively influence current attributes, which in turn are negatively affecting customer experience, can be ultimately defined as well grounded technological solutions for public transportation.

4. Results and Discussion

This section intends to present the outcomes documented by the field research, data collection from people with professional expertise in the public transportation of Lisbon, the Importance and Performance scores, the Exploratory Factor Analysis results, the Cluster Analysis results, the Importance and Performance Analysis by cluster, and the Implementations scores by cluster.

4.1 Preview of foreign practices

The insights provided by using the public transportation in other metropolises were plentiful. Although it had already been evidenced in section 2 that the implementation of new measures on public transportation services, on the areas of automation, digital navigation applications, projection and display, and ticketing, reflect on benefits for the passenger's experience, it was possible to further support those benefits, with special attention to the area of projection and display, due to being more visually explanatory. Regarding the automation, digital support and ticketing system areas, the collection of information through field notes is less expressive due to their fewer visual characteristics, as they have also been more heavily supported by the research papers' conclusions of their added value to public transport systems.

4.1.1 Projection and Display

The projection and display area, represents measures that allow the public transportation service to more conveniently provide information that benefits their passenger's experience, might this information be exposed in stops and stations as well as inside the transports. In fig. 4.1 it is shown an implementation (left) that displays audio voice after clicking, for assisting the passengers with disabilities on getting to know each bus's schedule. The other images (centre and right) provide a visualization of the real projected time of arrival in a clearer, more sophisticated way, with detailed information of the current stop of the next incoming bus.

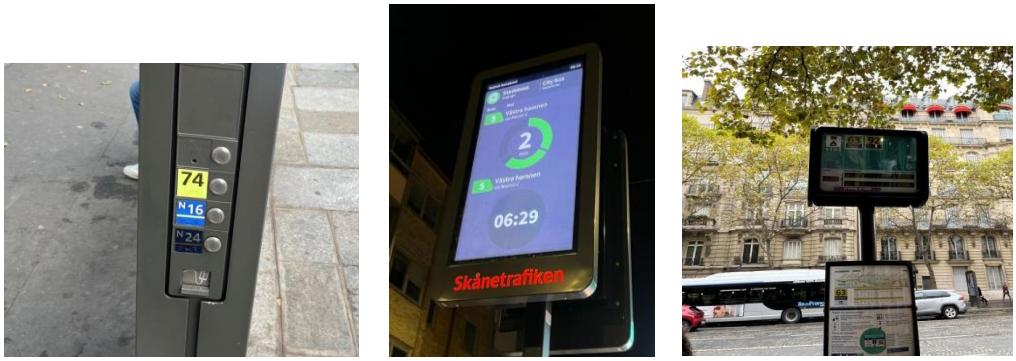

Figure 4.1 Display of information, Bus stops in Paris (audio), Malmö, Paris, respectively

In figure 4.2 there is the possibility to confirm that buses in metropolises such as Barcelona, Spain and Copenhagen, Denmark, provide a very complete set of information for passengers, from the current time, the specific bus's route, and the real time navigation of the bus. In Copenhagen (right) there is also the incremental aspect of providing the news, and although not evidenced in the picture, the meteorology and likewise information that can concern the passenger's day.

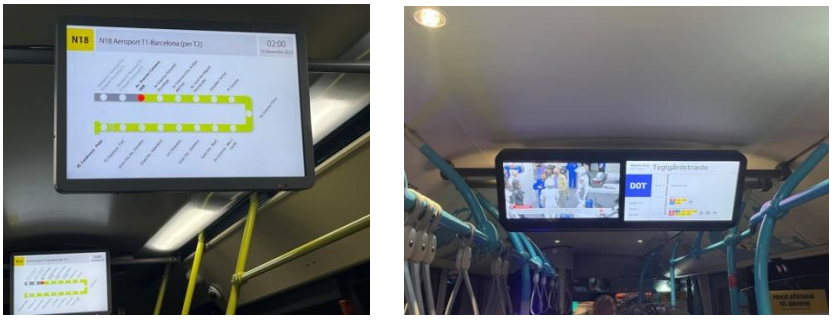

Figure 4.2 Display of information, Bus transport in Barcelona, Copenhagen, respectively

With focus on the metro service, the projection and display implementations are almost identical, which can be justified due to the similarity of the purpose these implementations represent, and that is more accurately inform the passengers. Such evidence shows that an implementation on an individual service transport can easily be adapted for the other public transports, therefore, as it affects positively a bigger scale of passengers, it becomes a more purposeful measure and economies of scale can be considered. In figure 4.3 we can see the display of information regarding the arrival of the next three metro trains, instead solely the next one (images one and three, counting from the left). The display layout is also more colourful and aligned with the metro environment, which transforms it into a more attractive station to be in. The second picture from figure 4.3 demonstrates a pleasant aspect to be aware of as a passenger, which is the position where the individual is when facing the train, if that individual stands below the display. The standing point is shown in red on top of the train's length. Image four is a digital guide on how to orientate in a transport hub for metro and train, which proves increased concerns in assisting all passengers, with special attention to the less used ones.

Figure 4.3 Display of information, Metro stations in Copenhagen, Copenhagen, Stockholm, Copenhagen, respectively

When it comes to space utilization for the benefit of all public transportation's shareholders, services around Europe have thought about possible increments that can improve the environment in metro stations, which brought forward interesting new implementations. The below Figure 4.4 disclosures ways of making stations more interactive with the passengers. The purposes for this implementation can vary, it can be used with intentions to transmit information to the passengers regarding the transport service, or regarding the city life and events, as the example from Barcelona indicates (left). The content being projected can also be more focused on proportionating a relaxing environment, more directed into transmitting comfort and entertainment into the passengers, as exemplified in a station from Malmö, a station where people used to visualize a concrete wall and can now appreciate recordings of their countries' beautiful sights (centre). The projection of content can also serve as a new stream of revenue to the operation services, by allowing brands to promote their advertisements in the station lines, as can be presented in the third picture (right). The new revenue stream can be reflected in a bigger budget for important maintenance costs or new infrastructure cost, ultimately resulting in potential for passenger's experience improvements. The advertisement can also be regulated into managing levels of profit while also improving the environment of the station, through adequate advertisement.

Figure 4.4 Projections of diverse content, Metro stations in Barcelona, Malmö, Barcelona, respectively

Inside of the metro transport, the identification of new implementations corresponded similarly to the ones documented inside of public buses, expressing the flexibility of the measures' adaptation. Figure 4.5 shows the inside of different metros, where it is visible the more reliable and visually appealing information about the trip and the metro lines' system. In the first image (left) we have the display of both net systems and live updates of the specific line. In image two (centre) and three (right) the displayed screen works similarly as the buses in Copenhagen previously exposed, with looping information regarding the status of the trip, meteorology, and city news.

Figure 4.5 Display of information, Metro transport in Malmö, Barcelona, Cracow, respectively

4.1.2 Ticket System

The ticket systems are becoming more seamless to passengers, as evidence of that reality It is shown in figure 4.6. The first image (left) shows the visual of the ticket application available for mobile phones. With a pleasant design, the application allows the purchase of all types of tickets available for public transportation and their validity works for all transportation services, being all tickets, multimodal tickets. The application is also an expression of the successful collaboration among the transport entities (which are still operating individually in Copenhagen). The ticket after purchased is saved in the app and can be extracted into other sources such as pdf. People know they must carry a ticket at all times, as there are more operators allocated in checking for tickets during trips, but besides such eventuality, passengers can comfortably enter on buses though any door of the bus, and can access the metro without any barrier system, therefore, with seamless ticketing implemented, the level of congestion of people decreases. The second image (right) demonstrates the possibility for people to purchase tickets inside of the metro train, simplifying the ticket purchasing process by adding the possibility for passengers to purchase it inside the transport.

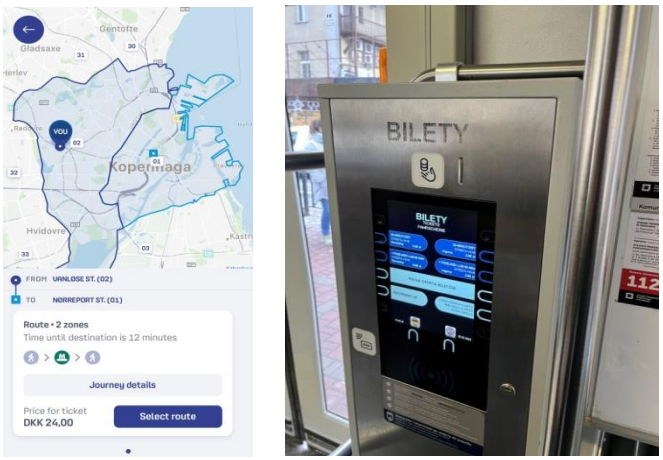

Figure 4.6 Ticketing application, multimodal in Copenhagen, Ticketing inside transport, Metro transport in Cracow

4.1.3 Digital support

An important contribute brought by the field notes into the digital support MaaS area, was by demonstrating that navigation applications that also operate in Lisbon, provide more information about the public transportation in some metropolises compared to Lisbon. This can only be justified by the allowance of the operating entities to provide data of their network and more importantly, GPS tracking. Although Lisbon's metro service already has implemented this feature in these digital platforms, there is uncertainty on why the same information can't be made available for the bus fleet. In figure 4.7 there is documented the functioning of bus live tracking in several European cities.

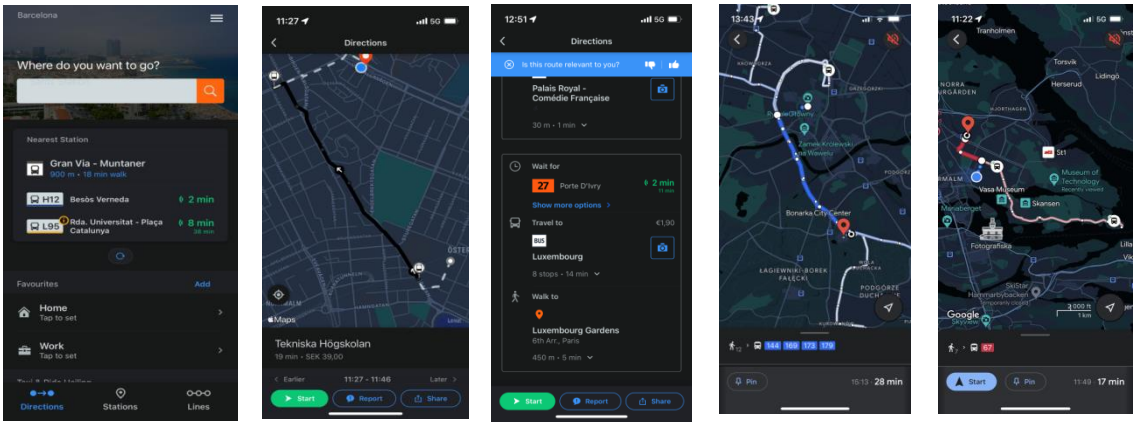

Figure 4.7 Navigation Apps of Bus in Barcelona, Stockholm, Paris, Barcelona, Cracow, Stockholm

A second documented digital implementation that has been empowering citizens into feeling more comfortable walking around their cities, ultimately resorting more into public transportation, is the use of the application The Citizen. This application relies on user engagement and is focused on the community sharing and exposing live threats around the city. The user can therefore visualise what is happening in any part of the city, as long the is another user recording and uploading that information. The application has gained attention in New York, where the amount of population is more expressive, and sources living in the city have expressed their satisfaction on being able to prevent going through certain areas, specially being a newcomer or tourist. The suggestion left in this study would be to further analyse the possibilities this could also present to the passengers in Lisbon, although it is left to debate the potential negative reflexion on some passengers, that being more aware of accidents and crimes, would develop a higher rejection towards using the public services of the city. The display of this implementation can be reviewed in the survey to passengers, Annex C.

4.1.4 Automation

The automation of the public transport service has been widely explored in this study, as it is the area of implementations that expresses the most scientifically reviewed benefits. In figure 4.8 it is possible

to visualise from the outside perspective (left) and the inside perspective (right), the Screen Doors System, the most common safety approach metro services take alongside with deciding to automate their metro lines.

Figure 4.8 Platform Screen Doors system, Metro station in Copenhagen

4.2 List of Implementations.

After the documentation of physical evidence of more ideas to improve passenger experience, the definition of the implementations was finalized. In Table 4.1, is provided a list of implementations that were supported by research papers and taken from field notes or proposed during the discussion of possible interventions with the professional Coordinator of Metro de Lisboa.

Table 4.1 List of potential Implementations for Bus and Metro transports in Lisbon

Implementation	Survey Question(s)	Explored in
Investment on maintaining a strong software for cyberattacks prevention	- How beneficial do you think developing and maintaining IT systems that prevent the possibility of cyber-attacks is?	- Meeting with professional: 3.1 Field Research
Automation	- Define how beneficial it is to implement technological measures aimed at reducing energy consumption in metro and bus transport. - Define how beneficial you consider to be, automating the service to prevent the frequency of disruptions. - Define how beneficial it would be to implement technological measures aimed at reducing the waiting time between each bus and metro.	- Literature Review: 2.3.2 Automation for Public Transportation - Field Notes: 4.1.4 Automation
Seamless ticketing option	- Would you consider that buying a virtual ticket before the trip, and present it to the transport staff would be beneficial for your experience as passenger?	- Literature Review: 2.3.1 Ticketing Innovation - Field Notes: 4.1.2 Ticketing Options

Multimodal ticketing option	- How beneficial you consider it to be, the implementation of a possibility for purchasing and managing tickets for all public transport in cities within the same mobile application.	- Literature Review: 2.3.1 Ticketing Innovation - Field Notes: 4.1.2 Ticketing Options
Mobile feature for user engagement	- In what way do you think it would be beneficial to pay more attention to sharing the contributions that your evaluations have made for the benefit of the service?	- Literature Review: 2.3.3 Digitalization for Public Transportation
Projection and display of content/Information	- How beneficial do you consider to be, the implementation of projection of informative and didactic content at stations and inside transports?	- Literature Review: 2.3.4 Projection and Display - Field Notes: 4.1.1 Projection and Display
Mobile feature for report on lost or suspicious items	- Indicate how beneficial you think it would be to implement a tool within navigation applications to immediately report suspicious items.	- Meeting with professional: 3.1 Field Research
Mobile features for the visibility of transport's usage footprint	- Indicate the benefit of being able to visualize an estimate of the ecological weight of each of the different travel alternatives proposed.	- Meeting with professional: 3.1 Field Research
Mobile feature on safety supported by crowd sharing	- How beneficial you consider it to be, having an app focused on sharing and receiving alerts of incidents that are occurring live around the city?	- Literature Review: 2.3.3 Digitalization for Public Transportation - Field Notes: 4.1.3 Digital Support
Insertion of Doors and Barriers	- How beneficial would you consider it to be, the implementation of technological measures aimed at reducing the risk of road accidents and people and objects falling into metro lines?	- Literature Review: 2.3.2 Automation for Public Transportation - Field Notes: 4.1.4 Automation
Mobile features for reliable information on the transport location	- Please indicate how beneficial you consider to be to have access to the current location and estimated arrival time of any transport you want to take.	- Literature Review: 2.3.3 Digitalization for Public Transportation - Field Notes: 4.1.3 Digital Support
Knowledge of entrance and exit areas	- How beneficial is knowing the entry/exit points of the carriages along the line before the Metro arrives?	- Field Notes: 4.1.4 Automation

4.3 Exploratory Factor Analysis results

The online survey gathered 305 participants, from which unfortunately 63 had to be withdrawn due to representing people with no experience in Lisbon's Metro and Bus transports. From the remaining 242 participants, 139 represent the metro service and 103 the bus service. For further analysis of the survey to participants see Annex C. With resource to SPSS v.26, the Exploratory Factor Analysis (EFA) was conceived through Principal Component Analysis (PCA) with Varimax rotation. For both bus and metro transportation services, this analysis had to be conducted several times, as the original 28 defined attributes presented inconsistent data for the continuity of the research. After the process of

elimination attributes with lower factor loadings and revaluation of the remaining, the Rotated Component Matrix expressed acceptable cross-loading between the attributes in both performance and importance. Regarding the bus transport, this analysis ended with 13 attributes selected. The Total Variance Explained for performance, demonstrated that the Eigenvalues shifted for less than 1.0 between four and five components, for both performance and importance, therefore, four components are to be used. In the performance scale the four components represent 65,12% of the total variance and in the importance scale 76,91. The Kaiser-Meyer-Olkin measure and Bartlett's test presented the acceptable values of 0.758 for KMO, and 0.000 of significance for Bartlett's sphericity test. For importance, the results present a KMO adequacy 0.882, with 0.00 significance. The Cronbach's alpha results for each of the components, in both performance and importance, registered all values well above 0.6.

In what concerns the EFA for the metro service, the rotated component matrix where the factor loading minimum requirements were met, evidenced results for 14 attributes. The Total Variance Explained for both performance and importance, demonstrated that the Eigenvalues shifted for less than 1.0 between four and five components, being that four components also will be used. In the performance scale the four components represent 64,49% of the total variance and in the importance scale 75,74%. The KMO and Bartlett's tests for performance, presented the acceptable values of 0.746 for KMO, and 0.000 of significance for Bartlett's sphericity test. For importance, the results present a KMO adequacy of 0.882, with 0.000 significance. The Cronbach's alpha results for each of the components, in both performance and importance, evidenced all values also well above 0.6. The Principal Component Analysis, KMO and Bartlett's tests, as well as the Cronbach tests for both transports are provided in Annex D.

The distribution of attributes for the bus and metro services was performed with respect to the components defined in the performance PCA, as performance represents the passenger satisfaction. The attributes for bus and for metro differ, which brings the positive aspect of enabling the study of more different attributes in general for public transportation. The four components for the bus service relatively matched the original dimensions they were allocated in the literature review from chapter 2, which represented a good sign. They are defined in this dissertation as follows, Reliability: *Time Waiting, Travel time, Punctuality,* Easiness: *Orientation, Seamless Ticketing, Planning capacity,* Safety: *Safety Waiting, Safety in PT, Drivers Attitude,* Service: *CS on site, Information in PT, App Accuracy, Information at Stations.* As for the metro service, the closeness of the attributes' grouping when compared to the original dimensions from previous studies was even more accurate, and is addressed as follows, Reliability: *Time Waiting, Travel time, Punctuality,* Easiness&Safety: *Orientation, Safety Surroundings, Safety Waiting, Safety in PT, Seamless Ticketing,* Comfort&Trust: *Security Measures,*

Emergency Reaction, Transport Appearance, Cleanse and Comfort, Information: *App Accuracy, Information at Stations*

4.4 Importance and Performance results

Considering the procedures described in chapter 3, and the new set of attributes for both bus and metro provided by the EFA, it can be performed the calculation of the average results for each attribute in terms of performance and importance, which will be later used to compose the IPA matrix and divide each attribute and component into the different quadrants. The presentation of the results obtained for the averages and gap regarding the Bus transport are provided in Table 1, while the same results for the metro service can be analysed in Table 2. From the 13 attributes, the attribute with the highest performance was *Safety in PT* (3,56), which refers to the safety inside the bus transports, while the lowest performance rated attribute was *Information at Stations* (1,89). Regarding importance, the highest rated attribute was *Safety in PT* (4,23), while the lowest rated attribute was *Information in PT* (3,66). The highest gap presented in bus service is regarding *Information at Stations* (-2,11) while the lowest is *Safety in PT* (-0,67).

Table 4.2 Average performance and importance scores for bus service attributes

	Bus Service Attributes	Average Performance	Average Importance	Gap
1	Time waiting	2,55	4,20	-1,65
2	Travel time	2,75	4,06	-1,31
3	Punctuality	2,27	4,19	-1,92
4	Orientation	3,20	3,89	-0,69
5	Safety Waiting	3,29	4,11	-0,82
6	Safety in PT	3,56	4,23	-0,67
7	Drivers Attitude	3,33	3,82	-0,49
8	CS on site	2,56	3,69	-1,13
9	Seamless Ticketing	3,04	3,95	-0,91
10	Planning Capacity	2,76	3,85	-1,10
11	Information in PT	2,49	3,66	-1,17
12	MaaS accuracy	2,36	4,10	-1,74
13	Information at stations	1,89	4,00	-2,11

Table 4.3 Average performance and importance scores for metro service attributes

	Metro Service Attributes	Average Performance	Average Importance	Gap
1	Time waiting	3,24	3,88	-0,64
2	Travel time	3,55	3,96	-0,41
3	Punctuality	3,14	3,81	-0,67
4	Orientation	3,86	3,91	-0,05
5	Safety Surroundings	3,35	3,88	-0,53
6	Safety Waiting	3,40	3,98	-0,58
7	Safety in Transport	3,45	4,04	-0,59
8	Security Measures	2,96	3,81	-0,86
9	Emergency Reaction	2,72	3,76	-1,04
10	Transport appearance	2,60	3,18	-0,58
11	Cleanse and Comfort	2,83	3,57	-0,73
12	Seamless Ticketing	3,76	3,95	-0,19
13	MaaS Accuracy	2,98	3,65	-0,67
14	Information at stations	3,03	3,80	-0,77

4.5 Cluster Analysis Results

In accordance with the tests' results previously obtained, combined with characteristics of socio-demographic diversity of the population sample, a Cluster Analysis was performed, providing this research with three, and four clusters of passengers for the bus and metro transports, respectively. The attributes used for the definition of clusters were the ones presenting the highest factor loading on each component extracted from the EFA. The components used for the bus transport were *Time Waiting, Safety in PT, CS on site, Planning Capacity,* while for the metro transport were *Punctuality, Emergency Reaction, App Accuracy.* With basis on previous research, the recommended number of clusters to be used should be comprised between more than two and less than six clusters. During the hierarchical approach for defining the optimal number of clusters for both transports, it was developed in SPSS v.26 a dendrogram using Wards linkage, where it was possible to see, for the bus, that only with three and four clusters we can obtain a good distance until the next sample refraction. A Chi-square test was also performed to see which cluster could be more suitable for this analysis, and the cluster three presented smaller Phi Values on all socio-demographic variables when compared to cluster 4. The same process was held for the metro transport, where the dendrogram presented good results for the usage of four or five clusters. The Phi values were identical this time, therefore the decision of choosing four clusters was made from rationalising the number of participants, where it was considered that there was no necessity to fragment the participants in five clusters. For visibility of the dendrograms and the Chi-square test on both transports, see Annex E. The test for re-allocation of the participants, K-means test, was also performed for both transports using the predefined number of three and four clusters on bus and metro respectively. The results of the socio-demographical results of each cluster are presented in Annex F for both bus and metro services. The socio-demographical characterization of each cluster for analysis in the bus transport can is described in the following way.

Cluster 1 represents the biggest number of people, with 52 participants. This cluster has the greatest proportion of female participants (63.46%), and nearly half participants use bus more than 5 times per week (48.08%). Cluster 1 comprises the highest share of people that use the bus transport for work purposes (57.69%) and has the highest proportion of people with at least a bachelor's degree (combined 86.54%). Participants report higher income levels when compared to clusters 2 and 3, with a combined 51.92% of participants earning more than 1200 euros.

Cluster 2 englobes 23 participants, having the largest proportion of people living outside Lisbon (43.48%). In this cluster the number of people from both genders is almost identical, with 52.17% of women and 47.83% of men. There is a very high share of people comprised between 18 and 25 years old (52.17%), being the largest representation of students (26.09%). It is the only cluster where most people don't own a personal vehicle (52.17%), although 82.61% have a driver's licence. The share of

people earning less than 800 euros is the highest, solely accounting with 34.78% of the cluster's sample. In Cluster two 53.17% of participants choose to not have the monthly transport ticket.

Cluster 3 comprises 28 participants, being the majority women (57.14%), and which has the highest share of people with more than 50 years of age (combined 32.14%). It represents the greatest sample of people from Lisbon (85.71%) from which 17.86% rarely use public transports. Cluster 3 englobes the largest share of people who use bus for leisure (28.57%), having the biggest proportion of people with a personal vehicle (67.86%). The proportion of people with a monthly ticket was the highest (60.71%), as well as the number of people living in an urban centre (67.86%).

Considering the clusters from the metro transportation, they can be represented as follows.

Cluster 1, with 24 respondents, has the highest share of women (70.83%). This cluster is represented by a vast majority of people between 25 and 49 years of age (combined 66.67%), with the largest share of people which purpose of taking the metro is for work (66.67%) and largely differentiated from the other clusters by having the greatest proportion of people using metro more than 5 times a week (58.33%). Cluster 1 represents the largest sample of people living in Lisbon (83.33%), with the highest share of people with a master's degree (58.33%) and lowest share of people earning more than 1700 euros per month after taxes. 66.67% of participants in cluster 1 own a private vehicle, the lowest proportion among the four clusters, as they also represent with distinction, the highest proportion of monthly ticket users of public transportation (70.83).

Cluster 2 is represented by 51 participants, 68.63% women. 45.10% of participants rarely commute by metro, being the purpose of commuting very split between leisure and work (35.29% and 39.22%, respectively). In this cluster, nearly half of the respondents are not from Lisbon. A proportion of 37.25% of people have between 50 and 66 years old, and the people that earn at least 1201 euros is the highest, with a combined value of 64.71%. In cluster 2 only 54.90% of participants live in an urban centre and the share of people that uses the monthly ticket for public transportation is also the lowest (45.10%)

Cluster 3 is represented by 23 participants, being 60.87% women. The participants in this cluster are mostly people with less than 34 years of age (combined 65.22%). The participants mostly commute for work purposes (65.22%) and almost everyone works for someone else (91.30%). The proportion of people without a driver's licence is the highest (15.69%), as 56.52% of people buy monthly tickets for public transports.

Cluster 4 englobes 41 participants, being the most balanced sample in terms of gender, with 56.10% of women and 43.90% of men. The is a high proportion of student people (14.63%) and people

between 18 and 25 years old (31.71%), although only 9.76% hasn't obtained a university degree yet. Participants mostly commute for leisure purposes (36.59%), also representing the highest share of participants who rarely use the metro service (48.78%). People from this cluster tend to earn slightly less when compared to the others, with a combined of 41.46% of people receiving less than 1200 euros per month after taxes. Cluster 4's participants have the greatest proportion of people who own a private vehicle, and the lowest proportion of people buying the monthly public transports ticket.

4.6 Bus transport: Importance-Performance Analysis results

On this subchapter, it will be reviewed the results obtained from the previous analyses through the visualization of the Importance-Performance matrixes. The tables providing the data of averages, standard deviations, confidence intervals, from which the matrixes were conceived are available for consultation in Annex G, as well as the matrixes for the components in each cluster and for the totality of the participants. As the main purpose for the continuation of the study is to collect attributes unveiling the worst performing results for each cluster, chapter 4 reserved focus on the Importance-Performance matrixes of the attributes per cluster.

4.6.1 Cluster 1

In Figure 4.9 is presented the results of the IPA for each attribute on cluster 1. From the IPA Analysis in Cluster 1, it is possible to identify that the average scores of performance (2.82) and importance (3.98) are similar to the averages of the total sample (2.77 and 3.98 respectively).

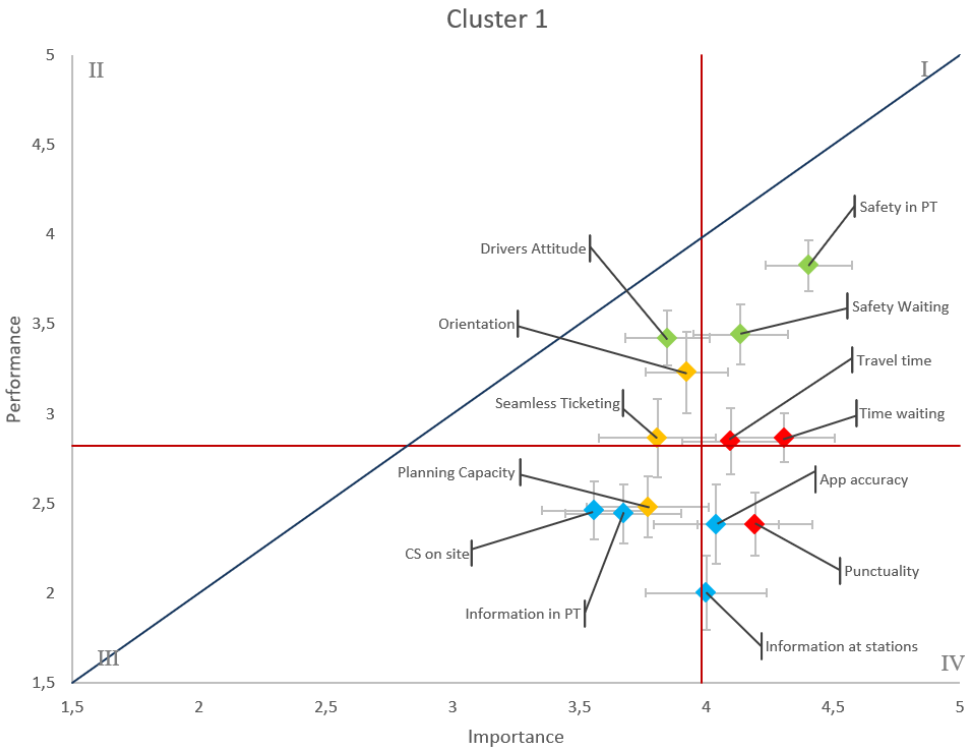

Figure 4.9 Importance – Performance Analysis (IPA) chart for attributes for Cluster 1. Note: quadrant thresholds are based on the mean of performance and importance scores. I = Keep up the good work, II = Possible overkill, III = Low priority, IV = Concentrate her

Reliability is the only component found in quadrant IV (see Annex G), indicating this area as the one showing the most negative results and the most in need for improvements. From the quadrant VI, *Information in stations* (-2.00) is the attribute with the largest gap result, followed by *Punctuality* (-1.81) and *App Accuracy* (-1.65). The attribute *Safety in PT* is described to be the attribute with the most positive results, with the smallest gap among the attributes from quadrant I (keep up the good work). As the purpose of this dissertation is to find solutions to improve the most critical negative-rated attributes in the service, the three attributes inserted in quadrant VI will be further analyzed.

4.6.2 Cluster 2

Cluster 2 presents lower averages of performance (2.16) and importance (3.86) when compared to the averages on performance (2.77) and importance (3.98) for all participants. This reflects in higher dissatisfaction than normal towards the service, among the people representing this cluster.

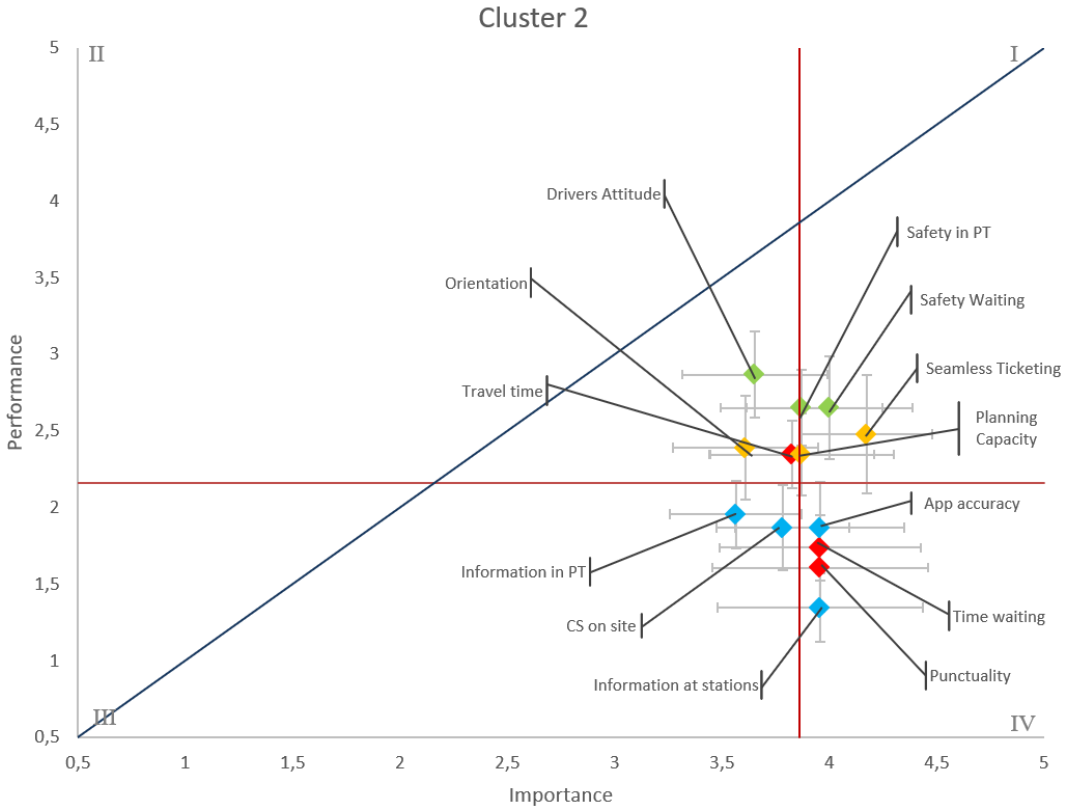

Figure 4.10 Importance – Performance Analysis (IPA) chart for attributes for Cluster 2. Note: quadrant thresholds are based on the mean of performance and importance scores. I = Keep up the good work, II = Possible overkill, III = Low priority, IV = Concentrate her

In Annex G it's possible to visualize that reliability is once again the only component in quadrant VI, although for cluster two we can clearly see very similar results on importance for all components, being the low levels of performance, the variable that distinguishes Reliability and Service from Easiness and Safety. As for the results of each attribute, Fig. 4.10 shows four attributes in quadrant VI. *Information at stations* presents the greatest gap (-2.61), followed by *Punctuality* (-2.35), *Time waiting* (-2.22), *and*

App Accuracy (-2.09). The confidence intervals in these attributes present some variability when it comes to importance, meaning that there is some disparity of opinions, where some people consider these attributes very important and others not as much. Nevertheless, the averages fall into quadrant IV so these are the attributes to be considered further on for improvement.

4.6.3 Cluster 3

In Cluster 3, the results are the opposite as observed on cluster 2, with the averages for both performance (3.19) and importance (4.08) presenting values above the total sample's averages (2.77 for performance and 3.98 for importance). In opposition with the conclusion of the previous cluster, the participants from this group seem to be some satisfied when it comes to looking into the general perspective of the service of public bus transportation. Figure 4.11 gives us the distribution of the attributes among the IPA matrix.

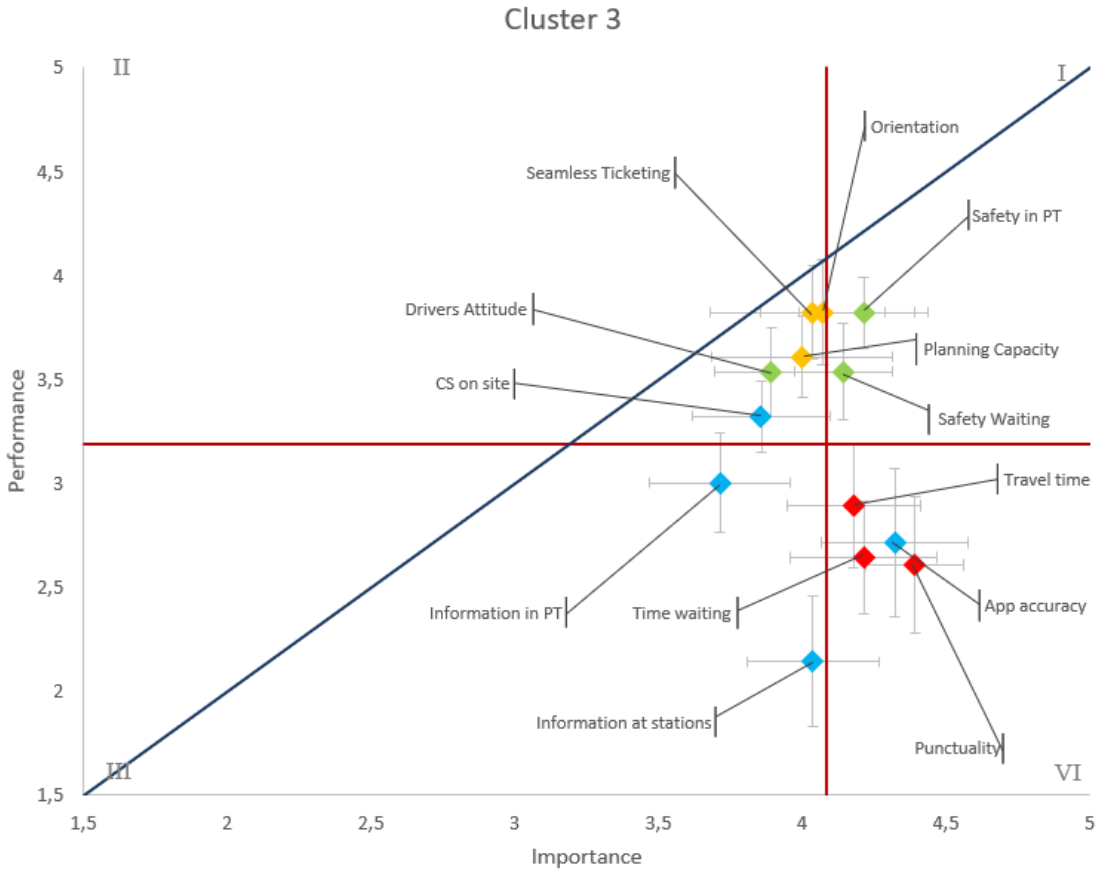

Figure 4.11 Importance-Performance Analysis (IPA) chart for attributes for Cluster 3. Note: quadrant thresholds are based on the mean of performance and importance scores. I = Keep up the good work, II = Possible overkill, III = Low priority, IV = Concentrate here.

The only component in quadrant IV was, like foreseen in the other clusters, the Reliability component (Annex G). Regarding each of the attributes, it is possible to identify four clusters in quadrant IV. The attributes that need more attention are, therefore, *Punctuality* (-1.79), *App Accuracy* (-1,61), *Time Waiting* (-1.57), and *Travel Time* (-1.29). Although *Information at stations* presents the greatest gap (-

1.89), it won't be considered for the analysis of solutions, as it falls under the quadrant which represent attributes with low priority to be improved.

4.7 Metro transport: Importance-Performance Analysis results

For this subchapter, it will be presented the results for each cluster of the metro service using IPA charts, and tables with the results on components and attributes. The passengers of the metro transportation have a superior level of satisfaction towards the public service of choice, when compared to the bus transportation's passengers, as can be concluded by the comparison of the gaps between the bus and metro in Tables 4.2 and 4.3. Even though this demonstrates a better presentation of the service from part of the metro operation to the citizens in Lisbon, it doesn't exclude the necessity to evaluate the most negative aspects of the service and find solutions to improve the passenger's experience, as it doesn't evidence in any way that the service performs well when it comes to passenger satisfaction. These results simply evidence that for the most part, the metro service has more satisfied passengers than the bus service.

4.7.1 Cluster 1

The first cluster for metro, evidence results on performance (2.94) and importance (3.70) below the averages of the total sample (3.21 for performance and 3.80 for importance). This indicates that people from this cluster tend to be more dissatisfied with the service in general.

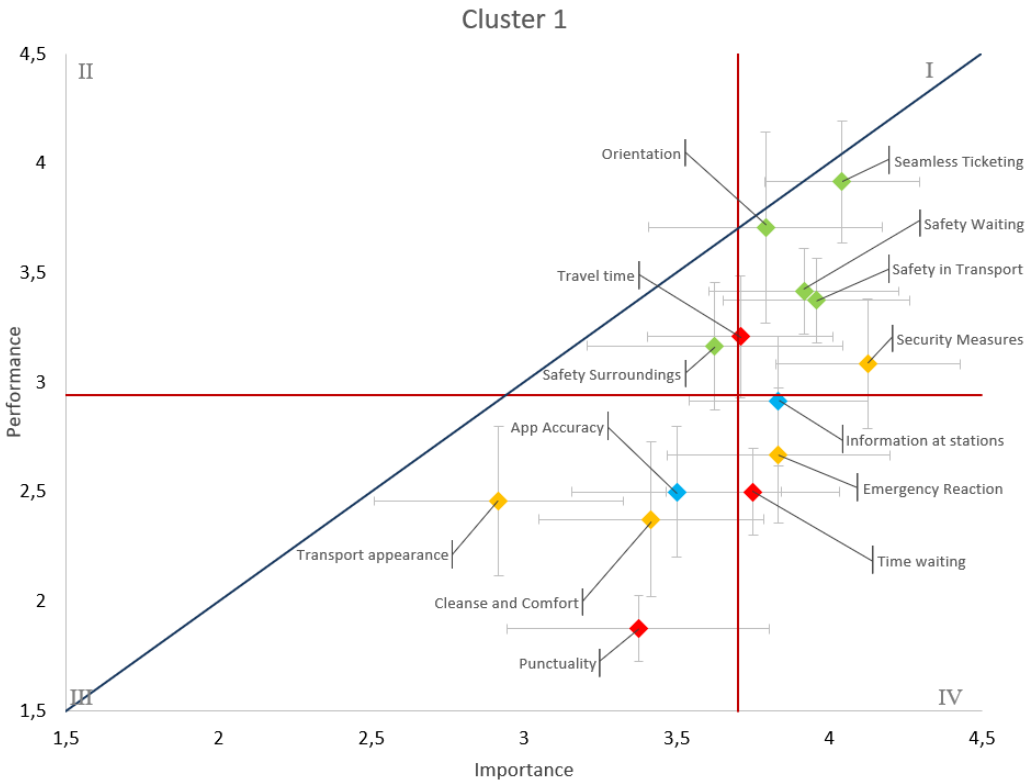

Figure 4.12 Importance-Performance Analysis (IPA) chart for attributes for Cluster 1. Note: quadrant thresholds are based on the mean of performance and importance scores. I = Keep up the good work, II = Possible overkill, III = Low priority, IV = Concentrate here

In Figure 4.12, the attributes are presented, distributed through the four different quadrants. The distribution of components can also be seen in Annex G, where in the present cluster, no component is inserted in quadrant IV, even though Information is found almost in the between of quadrants III and IV and has a significative variation of results in importance. Focusing on the distribution of the attributes in order to find the critical ones, it is possible to identify in quadrant IV the attributes *Time Waiting* (-1.25), *Emergency Reaction* (-1.17), and *Information at Stations* (-0.92). Punctuality and cleanse and comfort have also high gap values but are found in quadrant III, relatively distanced from quadrant IV, being that although the performance is very low, people seem to not give much value to it, in comparison to other attributes.

4.7.2 Cluster 2

Cluster 2 also evidences attributes' averages on both performance (3.09) and importance (3.70) below the total average of the sample (3.21 for performance and 3.80 for importance), although performance is perceived slightly superior, then participants considered it to be in cluster 1. Participants grouped in this cluster also find more dissatisfaction towards the metro service than the averages of the sample indicate. In cluster 2 there is an absence of components in quadrant IV (Annex G).

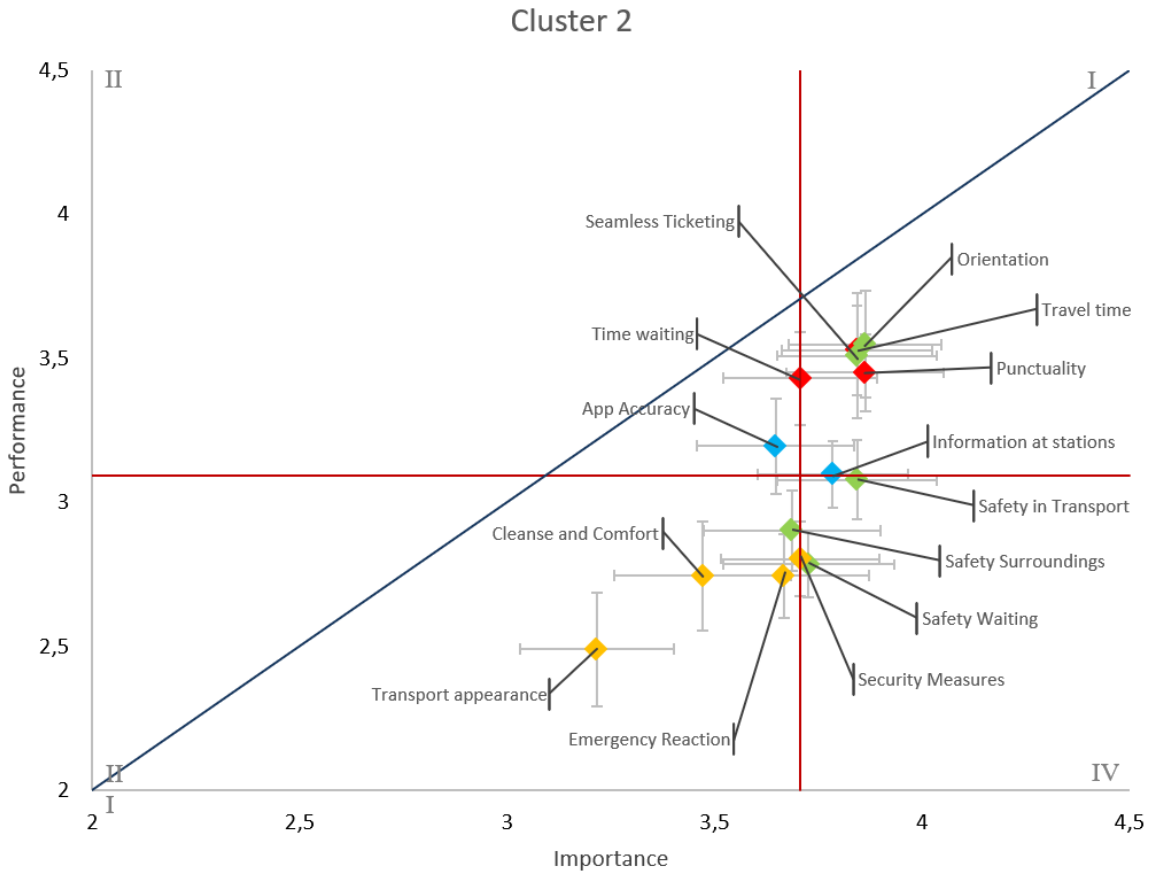

Figure 4.13 Importance-Performance Analysis (IPA) chart for attributes for Cluster 2. Note: quadrant thresholds are based on the mean of performance and importance scores. I = Keep up the good work, II = Possible overkill, III = Low priority, IV = Concentrate here

When it comes to each attribute being considered, the ones that fall into quadrant IV are *Safety Waiting* (-0.94), *Safety in Transport* (-0.76), *Security Measures* (-0.90). This cluster presented at least three more attributes that can very easily be further considered for improvements, that is, after solutions in the critical ones mentioned have been implemented. *Emergency Reaction* (-0.92) and *Safety Surroundings* (-0.69) were considered slightly less important that the average, while *Information at Stations* (-0.78) performs slightly better than the average performances of the service.

4.7.3 Cluster 3

The results retrieved from cluster 3 on the averages of both performance (2.94) and importance (3.68) are below the averages of the total participants (3.21 for performance and 3.80 for importance), representing once again, a group of participants more dissatisfied with the service in general. These values are almost identical to the results of cluster 1, with a slightly higher level of dissatisfaction in performance for cluster 3.

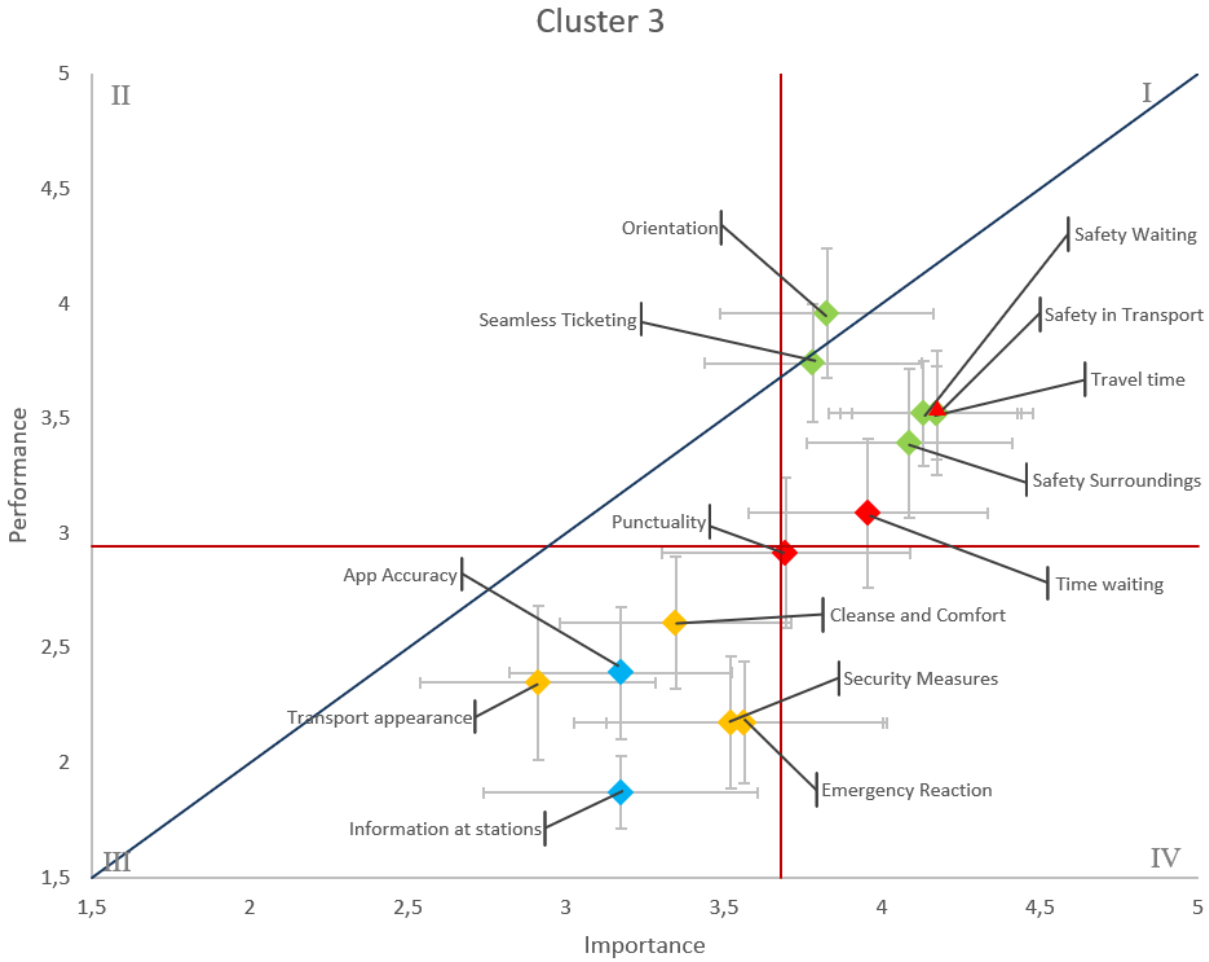

Figure 4.14 Importance-Performance Analysis (IPA) chart for attributes for Cluster 3. Note: quadrant thresholds are based on the mean of performance and importance scores. I = Keep up the good work, II = Possible overkill, III = Low priority, IV = Concentrate here

In this cluster however, one attribute is inserted in quadrant IV, which is *Punctuality* (-0,78), with only 3 other attributes with confidence intervals that provide relative grounds to consideration of being also improved, which is *Time Waiting,* (-0.87), *Security Measures* (-1.35) and *Emergency Reaction* (-1.39) (see Figure 4.14). The results from Annex G can evidence the absence of a component in quadrant IV.

4.7.4 Cluster 4

Cluster 4 evidence higher results on both performance (3.65) and importance (4.04) measurements, compared to the averages of total participants (3.21 for performance and 3.80 for importance). These results identify this cluster as the one with the people who are the most pleased with the service provided by the metro.

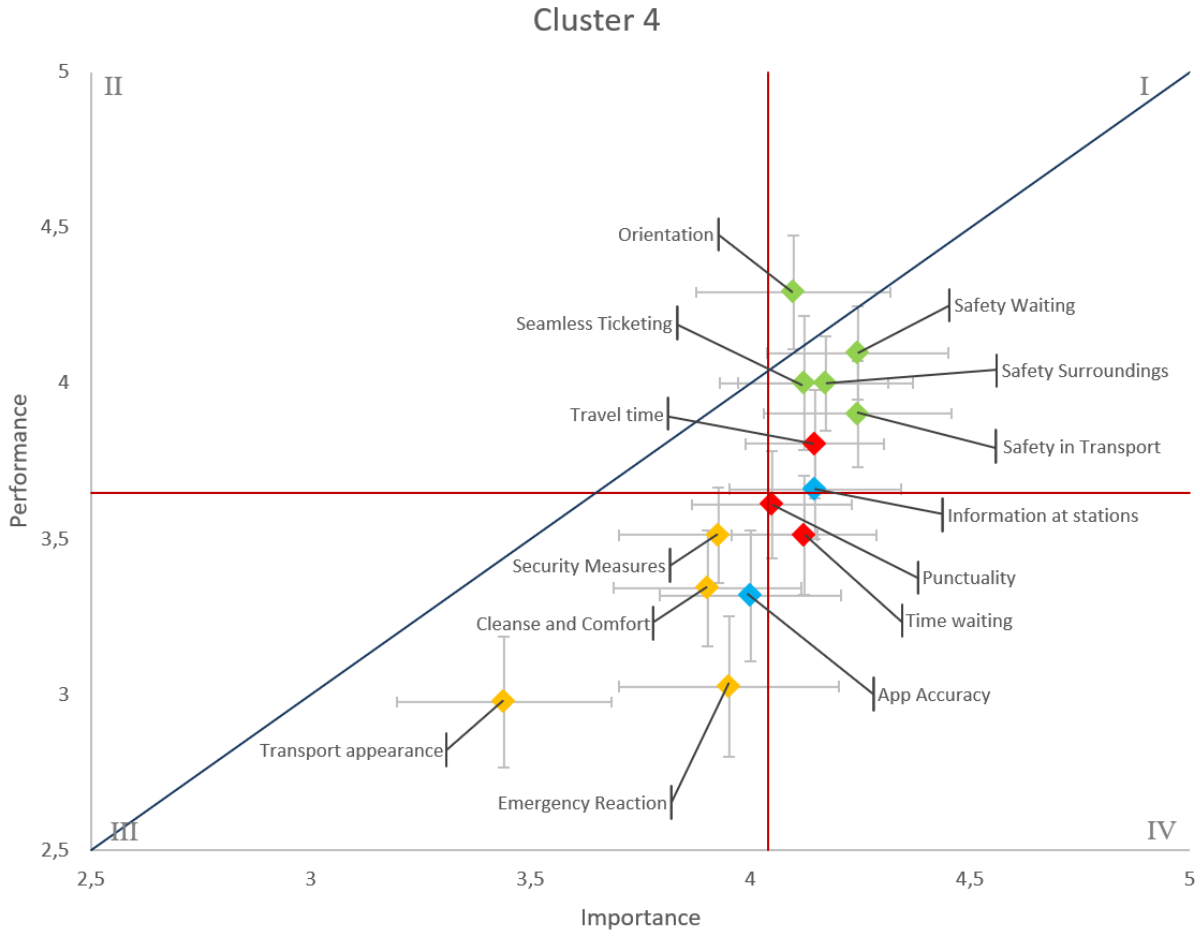

Figure 4.15 Importance-Performance Analysis (IPA) chart for attributes for Cluster 4. Note: quadrant thresholds are based on the mean of performance and importance scores. I = Keep up the good work, II = Possible overkill, III = Low priority, IV = Concentrate here

From cluster 4, two attributes are presented in quadrant IV, *Punctuality* (-0.44) and *Time Waiting* (-0.61). See Figure in Figure 4.15 the attributes' distribution. The attributes *Information at Stations* (-0.49) and *App accuracy Waiting* (-0.68) are presented respectively in quadrants II and III, but their closeness to become attributes that more negatively affect the passenger's experience, justifies the

identification of the component Information, to be the only component in quadrant IV, as can be reviewed in Annex G.

4.8 Implementations results and discussion for potential solutions.

The following subchapter aims to demonstrate how and which of the implementations discovered can affect positively the attributes with the most urge to be improved.

4.8.1 Bus service results and solutions

The collected implementations, summarized in subchapter 4.2, and the results retrieved from the Importance-Performance analysis for the bus service, provided the necessary output to align the critical attributes with the implementations that positively affect them. The result of the alignment of both attributes and dimensions can be viewed in Table 4.4.

Table 4.4 Critical attributes of bus transport and their allocation to potential implementations to benefit passenger experience

Implementation / Attribute	Mobile feature for user engagement	Projection and display of content/information	Seamless Ticketing Option	Reliable information on the transport location
Time Waiting	✓		✓	
Punctuality	✓			✓
Travel Time			✓	
App Accuracy	✓			✓
Information at Stations		✓		

Time Waiting was defined as a critical attribute by clusters 2 and 3. These clusters express the needs of people that have a moderate, and low dependency (respectively) towards the bus transport. While custer 2 englobes a high number of people that don't live in Lisbon, being that they also have the lowest proportion of monthly ticket buyers, cluster 3 is represented by older people that use the transport more rarely, and when they do, there is a higher chance of being for leisure purposes. This indicates that the passengers that are more dependent on this transport prioritise other attributes for improvement. This attribute can be improved through the development of strategies to create more user engagement in the navigation apps, because as demonstrated in subchapter 2.3.3, the more people interact with the service, the more data and feedback is provided to the developers of the service. By providing a better comprehension of the passenger experience, the measure allows the operation to redesign and optimize routes and time schedules. The "Seamless ticketing option"

proportionates less congestion of people which translates in reduced time needed for entreing the bus, and also for purchasing tickets in automatic machines, as well as the time purchasing them. Purchasing tickets is still a time wasting barrier because, even though there are online payment options, they are not well implemented, as the vast majority of people still resorts to automatic machines (65,47% for metro's total sample and 66,02% for bus's total sample). *Punctuality*, is a critical attribute for all three clusters, which raises elevated concern regarding its need for improvement. In a similar way that it was for *Time Waiting*, "Mobile feature for user engagement" also contributes for the increase of the *Punctuality* performance decause it allows to not only redesign the schedules, but also guarantee the evaluation of current travel times and elaborate more accurate routes to make the average arrival time to each station more reliable. The existence of "Reliable information on the transport location" can improve punctuality, because the visualization of this information by passengers, forces the operation to improve the perforamance levels, as not doing so, will increase complaints and can contribute for the loss of the more dissatisfied passengers. *Travel Time* is an attribute found critical among the participants of cluster 3, which makes this cluster the only that defined all reliability attributes as very negative for passenger experience. Being that the automation of buses is still far away from achieving good speed results compared to the conventional way, the only implementation to improve *Travel time* is the "Seamless ticketing option", as it eliminates the time the driver usually has to take in assisting people purchasing tickets. *App accuracy* is another attribute found critical for all thre clusters, which means that most passengers consider that it is crucial to have information of the current position of the bus they intend to take. It is possible to say that this dissatisfaction very well aligns with the issue on *Punctuality*, because low performance for both attributes, translate in uncertainty and stress, with passengers not having any information to decide how luch longer they shall wait for the bus that is running late. Both implementations acting for the improvement of this attribute have been reviewed towards *Punctuality*, and the reasons on their benefic value stand the same. *Information at Stations* is a critical attribute in the optic of participants from clusters 1 and 2. The clusters have the comom characteristic of representing frequent users of the bus transport, which suggests that people who resort more ofter to the bus service, would higly apreciate the implementation of information streams in stops and stations. For this low performning attibute, it can be implemented the "Projection and display of content/Information". This implementation has been taken in many other bus services, as evidenced in subchapter 4.1.1, and stands for providing all sorts of information that can be of the passenger's interest, such as the time on the incoming buses, the current stations of the incoming buses, the expected time of arrival, through a well desgined digital screen.

Table 4.5 Critical attributes of bus transport and their allocation to potential implementations to benefit passenger experience

Implementation	Question	Average Cluster 1	Average Cluster 2	Average Cluster 3
Mobile features for reliable information on the transport location	Please indicate how beneficial you consider to be to have access to the current location and estimated arrival time of any transport you want to take.	4,73	4,74	4,68
Mobile feature for user engagement	In what way do you think it would be beneficial to pay more attention to sharing the contributions that your evaluations have made for the benefit of the service?	3,71	4,61	4,29
Projection and display of content/Information	How beneficial do you consider to be, the implementation of projection of informative and didactic content at stations and inside transports?	3,87	4,52	4,25
Seamless ticketing option	Would you consider that buying a virtual ticket before the trip, and present it to the transport staff would be beneficial for your experience as passenger?	4,19	4,65	4,43

To which extent passengers found the implementations beneficial for their passenger experience, can be viewed in Table 4.5, in accordance to their answers for the stage 3 of the survey. The results express a high generalized interest in obtaining information of the live geographical position of the bus (above 4.65 for all clusters). The second most attractive implementation is the development of a seamless ticketing service (all values above 4 = “Plenty” beneficial). The other implementations also present a positive overview, although the variations on results are more pronounced between the clusters. Cluster 2, representing the greatest proportion of younger people, presents high attractiveness towards all implementations, while in cluster 1, with the most frequent users, the interest is more focused on what is perceived more convenient in solving their critical attributes. Cluster 3 expresses a similar behavior on prioritization of implementations as cluster 1, although gives more meaning of importance to all.

4.8.2 Metro service results and solutions

The metro service presents more critical attributes, which indicates that, while in the bus service there are well-defined attributes as being the source behind a limited passenger experience, for the metro service, people have more different opinions on what is the root cause of their dissatisfaction towards the service. In Table 4.6 is demonstrated how the critical attributes are aligned with each implementation. The Implementations, Mobile feature for user engagement, and Projection and display of content/information, won’t be justified, as these implementations have been previously explored for the bus transport. Their conditions to be implemented are close to identical on both transports, and the attributes they are intended to influence are the same ones as before.

Table 4.6 Critical attributes of bus transport and their allocation to potential implementations to benefit passenger experience

Implementation / Attribute	Mobile feature for user engagement	Projection and display of content/information	Mobile feature on safety supported by crowd sharing	Insertion of Doors and Barriers	Automation	Seamless Ticketing Option
Time Waiting	✓				✓	✓
Punctuality	✓				✓	
Safety Waiting			✓		✓	
Safety in Transport			✓		✓	
Security Measures			✓	✓		
Emergency Reaction			✓	✓	✓	✓
Information at Stations		✓				

Time waiting was a critical factor for clusters 1 and 4 of the metro service's participants. Their socio-demographic characterization is dinstinct in terms of transport usage, but shares two common points, representing mostly young participants, and participants who obtain lower income per month. Active young workers and students therefore consider that one source of dissatisfaction towards the service is the time they wait for the next metro. "Automation" is a domain of implementations from which its benefits have been deeply explored in the subchapter 2.3.2. Some of those benefits tend to improve the capacity of the service in terms of transport speed and the decrease of disruptions, making it more reliable and improving its frequency, which justified its alignment with the attribute *Time Waiting.* The "Seamless ticketing option" is another option for improving *Time Waiting's* performance as it eliminates time-wasting features previously mentioned for people who use bus, such as waiting in line to buy a ticket and the process of buying the ticket, but also, because sometimes there are waiting lines of people to cross the security turnstiles. *Punctuality* is a critical factor in clusters 3 and 4, which possess the similarity of representing participants of young age. Altough in cluster 3 people are more dependent to public transportation, with the majority buying the monthly ticket, in cluster 4 that is not the case, participants don't commute very frequently, and tend to own more personal vehicles, which suggests that young people in general, either due to their daily routine, or due to low income, focus more on the time they lose while waiting for the metro. "Automation" can reflect benefits on this attribute in the same way it does to *Time Waiting*, therefore they won't be mentioed again. *Safety Waiting* and *Safety in Transport* are critical attributes for Cluster 2, which is the cluster presenting the proportion of people who commute the least and with the most advanced age. People from this cluster also earn more montlhy, comparing to the other clusters. The mentioned characteristics might justify a lower dependency towards metro, where the sense of satisfaction is more heavily influenced by

feeling safe instead of optimizing the time. There are two implementations linked to these two attributes, “Mobile feature on safety supported by crowd sharing” and “Automation”. The first is based on exposing the threats that exist along the way when passengers are commuting, if criminal acts are easily catured and people develop a sense of community sharing incidents, this translates into a decrease on the probability of people considering repeating those same acts. “Automation” can also compose benefits into both attributes because an automated line means more availability of operators to be allocated in control and customer service tasks. The existence of responsible elements of the service close to the passengers brings a new sense of protection that pleases specialy the more concerned ones. *Security measures* is considered a critical attribute by participants from cluster 2. As mentioned before, this cluster comprises older participants that less frequenctly commute by metro, which by combining the safety attributes reviewed above, suggests that these participants give a special level of importance regarding feeling safe and secure when using the metro. Being positively influenced by “Mobile feature on safety supported by crowd sharing” in the same way as the other attributes, *Security measures* is influenced as well by the implementation of “Insertion of doors and barriers”. This measure is, in most cases, implemented alongside the process of automation of the lines, because for the automatic doors to properly give access to the metro, it has to stop in the same place as the doors are positioned (see subchapter 4.1.4 for a visual representation). Platform screen doors (PSD) are mostly implemented to handle the safety concern of the risk of accidents, people and items falling into the line. With a PSD system, there are no chances for such accidents to happen, which instantly makes the service more safe, and which is why it positively influences *Security Measures.* The attribute *Emergency Reaction* is considered a critical attribute for participants from cluster 1. As a result, the participants who more frequently commute by metro don’t consider that the metro service provides with fast and coordinated means to guarantee the security of its passengers in case of an emergency. In order to aleviate the performance of the service in this attribute, there is the “Mobile feature on safety supported by crowd sharing”, “Insertion of doors and barriers”, “Automation”, and “Seamless ticketing option”. Although the reasons for a positive influence from the first two implementations mentioned are the same as the ones explored above, and in “Automation” they are the same specifically for the safety attributes, in the “Seamless ticketing option” there is a further point to take into account. With the implementation of a seamless ticketing, the turnstiles for validation could be removed. This removal proportionates an easier flow of people entering and leaving the metro, which in the possibility of an accident or emergency, could become crucial for the passengers and for the efficiency of assistance from the help units.

Table 4.7 Critical attributes of bus transport and their allocation to potential implementations to benefit passenger experience

Implementation	Question	Average Cluster 1	Average Cluster 2	Average Cluster 3	Average Cluster 4
Automation	Define how beneficial it would be to implement technological measures aimed at reducing the waiting time between each bus and metro.	4,83	4,63	4,87	4,78
Mobile feature for user engagement	In what way do you think it would be beneficial to pay more attention to sharing the contributions that your evaluations have made for the benefit of the service?	4,29	4,24	4,17	4,15
Projection and display of content/Information	How beneficial do you consider to be, the implementation of projection of informative and didactic content at stations and inside transports?	4,00	4,16	3,74	4,00
Seamless ticketing option	Would you consider that buying a virtual ticket before the trip, and present it to the transport staff would be beneficial for your experience as passenger?	3,92	4,29	4,3	4,41
Insertion of Doors and Barriers	How beneficial would you consider it to be, the implementation of technological measures aimed at reducing the risk of road accidents and people and objects falling into metro lines?	4,71	4,61	4,48	4,61
Mobile feature on safety supported by crowd sharing	How beneficial you consider it to be, having an app focused on sharing and receiving alerts of incidents that are occurring live around the city?	4,33	4,14	3,96	4,32

The ratings given on importance to each of the discussed implementations are available in Table 4.7. The participants from all clusters present a very high interest on seeing implemented automated lines (averages above 4.60), which can be justified by its presence on improving five of the seven critical attributes, in three of the four components. Another attribute with very positive reviews is the implementations of platform screen doors, comprising values above 4.45 out of 5 in levels on importance given. The other attributes also present rates above four for most clusters although are not identified as much of a priority as mentioned two. In terms of the cluster's prominence towards the implementations, cluster 1 demonstrates a prioritization on the attributes that influence safety and security concerns, which being the most frequent users from the four samples, raises once again, concerns on the performance of the service on the safety dimension. Cluster 2 doesn't have a defined prioritization of what is most important, because although having ranked automation and the insertion of PSD measures higher, the variability between all measures is less significative than among the other clusters. All implementations are considered positive (above 4.10). Regarding cluster 3, the results were the highest for automation, which suggests that the cluster with the highest proportion of young active workers have a well-grounded prioritization of wanting the metro lines automated. The interest of having implement the projection and display of content and information is expressively low. Cluster

4 presents very similar results to cluster 1, with exception on their position regarding the insertion of a seamless ticketing system, where participants consider it a very positive implementation (4.41) in contrast to cluster 1 (3.92).

4.9 Professional review on new Implementations

The level of alignment between the professionals and the passengers' perspective in implementing the addressed solutions can be reviewed by comparing the results gathered in the subchapter 4.8 with the ones provided by the data collected from the survey for professional elements, demonstrated in Table 4.8. In this survey, from which its results can be reviewed in Annex I, 23 professionals specialized in the bus and metro public transports were gathered, and shared their professional view on the levels of importance that each measure conceives to the passenger's experience. Upon the characterization of the individuals, more than half has more than 10 years of experience. The field of specialization encompassed, engineers, electrical workers, drivers, project managers, finance officers, salespeople, and direction, which brings a diversified view from all the service's stream. Due to due to the expected high difficulty on collecting results from professionals, the sample was not divided by the two transport modes, and data shall be analysed from a global perspective.

Table 4.8 Ratings on Importance on critical attributes' influencing Implementations. Results of professionals

Implementation	Question	Average
Automation	Define how beneficial it would be to implement technological measures aimed at reducing the waiting time between each bus and metro.	4,09
Mobile features for reliable information on the transport location	Please indicate how beneficial you consider to be to have access to the current location and estimated arrival time of any transport you want to take.	4,61
Mobile feature for user engagement	In what way do you think it would be beneficial to pay more attention to sharing the contributions that your evaluations have made for the benefit of the service?	3,83
Projection and display of content/Information	How beneficial do you consider to be, the implementation of projection of informative and didactic content at stations and inside transports?	3,74
Seamless ticketing option	Would you consider that buying a virtual ticket before the trip, and present it to the transport staff would be beneficial for your experience as passenger?	4,43
Insertion of Doors and Barriers	How beneficial would you consider it to be, the implementation of technological measures aimed at reducing the risk of road accidents and people and objects falling into metro lines?	4,13
Mobile feature on safety supported by crowd sharing	How beneficial you consider it to be, having an app focused on sharing and receiving alerts of incidents that are occurring live around the city?	3,74

Similarly to the evidenced from the passengers' results, professionals ranked all implementations relatively high, which indicates an acknowledgement of the implementations as having potential to improve passenger experience. The highest-rated indicator was "Mobile features for reliable information on the transport location" (4.61), a result that prioritizes the implementation that

positively influences critical attributes named by all three clusters of passengers. The commonality on importance between passengers and professionals towards this implementation brings further evidence on its likeliness on becoming very beneficial for the service. Professionals also find “Seamless ticketing options” an important measure to be taken into consideration (4.43), as the value they believe that could bring to passenger experience is higher than the values reported on five of the seven clusters of participants. This can be justified by some professionals forecasting the additional benefit of obtaining more flexibility to perform better at their roles. Additionally, “Seamless ticketing options” is an implementation that equally affects both transport modes, therefore being a measure that satisfies more audience than implementations specific to their transports. “Automation” was ranked by passengers as the implementation to be prioritized, although professionals don’t perceive this to be the most important one to improve passenger experience. With a positive but not distinguished result of (4.09), this measure questions the level of alignment between passengers and the operation, on what brings more value to the passenger experience. Clearer evidence of discrepancy between the results collected from professionals and the passengers is visible on “Mobile feature for user engagement” (3.83). Professionals express to not be as keen as passengers, into considering that promoting passengers to be more active into the improvement of the service, would present successful results. This result suggests that the operation discredits the interest of the passengers into contributing for improvements, when passengers might be more willing to cooperate.

5. Conclusion, limitations, and future research

5.1 Conclusion

This dissertation managed to evidence areas on the service of public transportation, where the insertion of technological implementations has a high propensity to improve passenger experience. Meticulously reviewed scientific literature provided the grounds for a well-oriented adventure in searching and documenting practices that might present conditions to be implemented in Lisbon and improving the lives of thousands of individuals, who everyday commute by the bus and metro services. Due to the consideration of fundamental validation tests, with aim to guarantee best accuracy of the results, 13 attributes were found to be representative of the bus public transport, and 14 attributes for the public transport of the metro. The introduction of reliability tests dismissed several other attributes that have been widely explored in other research papers and may also be important to include in future analyses. Further research led to the establishment of four components of each of the transport. With regards to the bus service, the components were qualified in the dimensions of Reliability, Easiness, Safety and Service. Considering the metro service, its dimensions were defined as Reliability, Easiness and Safety, Comfort and Trust, Information. Each of the components were labelled in accordance with the intrinsic representation of the attributes that compose them. The two samples of participants from both transports were further reviewed through socio-demographically distinct clusters of people. The availability of different profiles of passengers favoured a more comprehensive analysis of each service, where many different conclusions can be taken into consideration regarding the future of public transportation. This dissertation assumed the existence of scarce resources to invest in improvements. From this assumption, the focus was centred in evidencing the solutions that are significative for the alteration of underperforming attributes from which people give high importance, combined with presenting the highest results of attractiveness from the optic of the passengers, which left other potential solutions aside. Considering the bus public transport, the results reveal the implementation of “Mobile features for reliable information on the transport location”, as the one to be prioritized upon implementation. Providing passengers with such resource would positively influence the two only attributes presenting negative results in the Importance-Performance Analysis for all three clusters of the service. Additionally, the passengers from all clusters favoured this implementation as the most important to be made effective in the service. Regarding the metro service, “Automation” was recognized as the most complete implementation, with potential to positively improve satisfaction in three of the four components that comprises the service. Aligned with such distinction, automation was recognised by participants as the most important measure to be implemented. Honourable mentions to “Seamless ticketing options” and “Mobile feature for user

engagement", because although not presenting the level of confidence into providing the best allocation of investment, are implementations that would influence both services, which taken as a perspective on economies of scope, should be also taken into perspective.

5.2 Limitations

The development of this dissertation was focused on providing the most appropriate solutions considering a prioritization needs due to scarce resources for investing, but it didn't provide a concrete budget model that could be used as variable to better define the possible implementation. Automation for instance, can become an expensive project, that although tends to express a positive return on investment with time, comprises high initial costs.

A second aspect to consider is the high latency on which the passenger sense of necessity can change. In a period of constant adaptation, factors such as technological developments, black swan events, economical shifts, influence the behaviour of the people in a way that there is no possibility to guarantee with absolute confidence that the described solutions will bring the best results to passenger experience. The forecast of what might be the biggest challenge of tomorrow is still an essential need, as other factors can remain unchanged, and the evolution of the service towards sustainability, innovation, efficiency, economic growth, and passenger satisfaction prepares the public transportation service to become flexible and adapt more easily to what might be the future.

With regards to the analysis of the results, the learning curve reflected aspects that would benefit from amendment in future analyses. To start with the number of participants, although it is scientifically accepted to conduct an IPA research study with more than 100 participants, it is believed that a higher sample of participants would have even better results, as the confidence intervals for instance, presented more variance and frequently fell into different quadrants from their mean. This limitation came from the ambition of solving constraints for the great majority of public transportation passengers, that led to the division of the 305 participants into options between one of the transport modes, by preference and frequency. The second aspect that proportionated a bigger challenge on gathering data is the specific profile of people being gathered as participants. This study had to exclude 63 participants that considered to not have enough experience in any of the two transports, as this study was also focused on reaching people with more likeliness on using public transport in Lisbon. Seasonality and weather might also represent an impact on the responses from passengers, as the results were documented during the summer period.

5.3 Future research

This dissertation presents likeliness on being the first study using the Importance-Performance analysis for the evaluation of passenger satisfaction in the public transports of Lisbon, and it can serve as guideline for future research. It is encouraged to dedicate more efforts into developing greater samples of participants for Cluster Analysis and Importance-Performance Analysis. Furthermore, a more rigid kind of approach can be performed for a more grounded confirmation of the results found in this study, through a Confirmatory Factor Analysis.

Some researchers choose to identify asymmetric relationships between performance and importance, considering that attributes performance affects differently passenger satisfaction. This theory is defined as the Kano's three-factor theory and defined attributes into performance factors, basic factors, and excitement factors, depending on their effect on satisfaction. To not extend this dissertation's analysis, it was opted to pursue the most common approach, by defining attributes as performance attributes, where low performance will cause dissatisfaction and high-performance causes satisfaction. More extensive research incorporating this theory into the Importance-Performance Analysis can provided different results and it would be fruitful to understand how it might change the recommendations for improving the passenger experience.

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7. ANNEXES

ANNEX A – KOLMOGOROV-SMIRNOV TESTS, BUS AND METRO

One-Sample Kolmogorov-Smirnov Test Performance	
	Asymp. Sig. (2-tailed)
1) O tempo que espero pelo autocarro é aceitável.	,000[c]
2) Eu chego depressa ao meu destino quando ando de autocarro.	,000[c]
3) Considero que os autocarros respeitam o horário estabelecido e aprecio a sua pontualidade.	,000[c]
4) É fácil para mim orientar-me nas estações de autocarro e quando faço ligações com outros transportes.	,000[c]
9) Sinto-me seguro/a enquanto espero na estação pelo autocarro.	,000[c]
10) Sinto-me seguro/a dentro do autocarro durante uma viagem.	,000[c]
16) Sinto que os condutores de autocarro têm uma boa atitude perante mim.	,000[c]

One-Sample Kolmogorov-Smirnov Test Importance	
	Asymp. Sig. (2-tailed)
1) O tempo que espero pelo autocarro é aceitável.	,000[c]
2) Eu chego depressa ao meu destino quando ando de autocarro.	,000[c]
3) Considero que os autocarros respeitam o horário estabelecido e aprecio a sua pontualidade.	,000[c]
4) É fácil para mim orientar-me nas estações de autocarro e quando faço ligações com outros transportes.	,000[c]
9) Sinto-me seguro/a enquanto espero na estação pelo autocarro.	,000[c]
10) Sinto-me seguro/a dentro do autocarro durante uma viagem.	,000[c]
16) Sinto que os condutores de autocarro têm uma boa atitude perante mim.	,000[c]

21) As pessoas que trabalham nas estações de autocarro estão sempre disponíveis para ajudar-me se precisar.	,000[c]		21) As pessoas que trabalham nas estações de autocarro estão sempre disponíveis para ajudar-me se precisar.	,000[c]
22) É fácil para mim efetuar a compra de bilhetes de autocarro.	,000[c]		22) É fácil para mim efetuar a compra de bilhetes de autocarro.	,000[c]
25) É fácil para mim recolher informação antes e durante o decorrer de uma viagem.	,000[c]		25) É fácil para mim recolher informação antes e durante o decorrer de uma viagem.	,000[c]
26) Considero que dentro dos autocarros é-me fornecida toda a informação que pretendo sobre a viagem.	,000[c]		26) Considero que dentro dos autocarros é-me fornecida toda a informação que pretendo sobre a viagem.	,000[c]
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do autocarro e relacionada com o funcionamento da rede de autocarros.	,000[c]		27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do autocarro e relacionada com o funcionamento da rede de autocarros.	,000[c]
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de autocarro de forma imediata e bem visível.	,000[c]		28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de autocarro de forma imediata e bem visível.	,000[c]

Item 9.1 - Kolmogorov-Smirnov Test, Bus Transportation (own authorship)

One-Sample Kolmogorov-Smirnov Test Performance			One-Sample Kolmogorov-Smirnov Test Importance	
	Asymp. Sig. (2-tailed)			Asymp. Sig. (2-tailed)
1) O tempo que espero pelo metro é aceitável.	,000[c]		1) O tempo que espero pelo metro é aceitável.	,000[c]
2) Eu chego depressa ao meu destino quando ando de metro.	,000[c]		2) Eu chego depressa ao meu destino quando ando de metro.	,000[c]
3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua pontualidade.	,000[c]		3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua pontualidade.	,000[c]
4) É fácil para mim orientar-me nas estações de metro e quando faço ligações com outros transportes.	,000[c]		4) É fácil para mim orientar-me nas estações de metro e quando faço ligações com outros transportes.	,000[c]
8) Sinto-me segura/o quando me encaminho para a estação de metro.	,000[c]		8) Sinto-me segura/o quando me encaminho para a estação de metro.	,000[c]
9) Sinto-me seguro/a enquanto espero na estação de metro.	,000[c]		9) Sinto-me seguro/a enquanto espero na estação de metro.	,000[c]
10) Sinto-me seguro/a dentro do metro durante uma viagem.	,000[c]		10) Sinto-me seguro/a dentro do metro durante uma viagem.	,000[c]
13) Sinto que o metro tem as medidas necessárias implementadas contra possíveis acidentes.	,000[c]		13) Sinto que o metro tem as medidas necessárias implementadas contra possíveis acidentes.	,000[c]
14) Em caso de emergência dentro do metro ou na estação, sei a polícia e os elementos responsáveis por garantir a segurança dos	,000[c]		14) Em caso de emergência dentro do metro ou na estação, sei a polícia e os elementos responsáveis por garantir a segurança dos passageiros	,000[c]

passageiros reagem de forma rápida e coordenada.			reagem de forma rápida e coordenada.	
18) Eu considero que as carruagens do metro têm um aspeto novo e apelativo.	,000[c]		18) Eu considero que as carruagens do metro têm um aspeto novo e apelativo.	,000[c]
19) Considero que o ambiente das estações de metro é limpo e confortável.	,000[c]		19) Considero que o ambiente das estações de metro é limpo e confortável.	,000[c]
22) É fácil para mim efetuar a compra de bilhetes de metro.	,000[c]		22) É fácil para mim efetuar a compra de bilhetes de metro.	,000[c]
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do metro e relacionada com o funcionamento das linhas de metro.	,000[c]		27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do metro e relacionada com o funcionamento das linhas de metro.	,000[c]
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de metro de forma imediata e bem visível.	,000[c]		28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de metro de forma imediata e bem visível.	,000[c]

Item 9.2 - Kolmogorov-Smirnov Test, Metro Transportation (own authorship)

ANNEX B – SKEWNESS AND KURTOSIS TESTS – BUS AND METRO

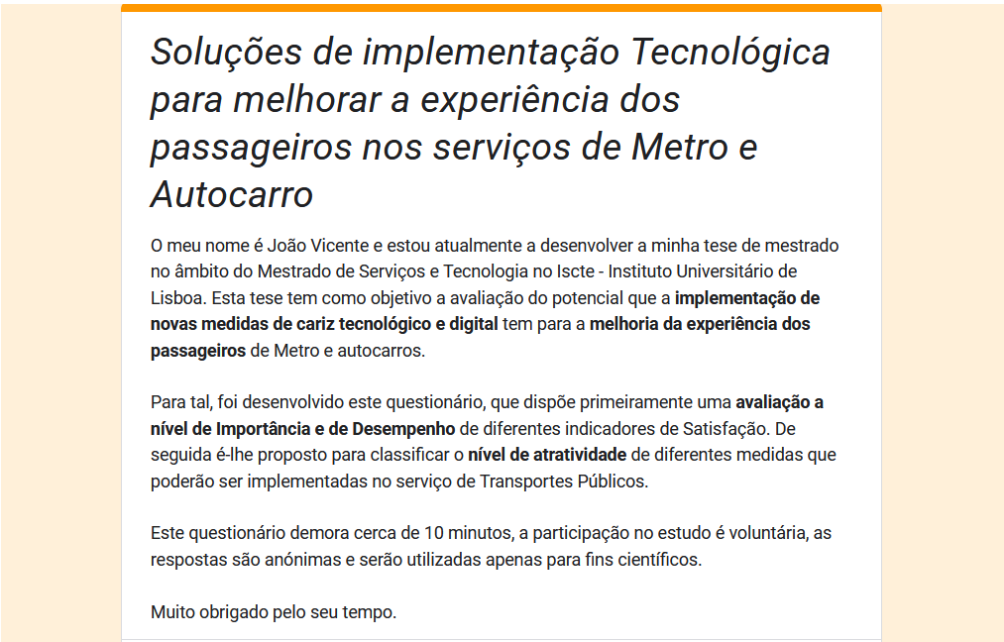
Performance			Importance	
Z value Skewness	Z value Kurtosis		Z value Skewness	Z value Kurtosis
-0.03491	0.221405		-4.68922	1.564475
1.703001	-0.51797		-3.88347	1.38991
1.824249	-0.65717		-6.15108	3.568225
-1.14187	-1.11669		-2.94436	2.606827
-2.53967	0.962615		-4.27643	2.951995
-3.21085	2.444525		-4.67619	3.465513
-0.1953	0.862446		-2.36272	1.994119
-0.63971	-1.2151		-1.74316	-0.51806
-0.75795	-1.09658		-4.07859	1.755396
-0.39216	-0.12175		-3.68635	0.777398
0.20283	-0.89791		-4.26809	2.526508
1.054583	-1.36653		-4.58435	1.206381
1.854599	-2.56632		-4.36551	1.357149

Item 9.3 - Skewness and Kurtosis Test, Bus Transportation (own authorship)

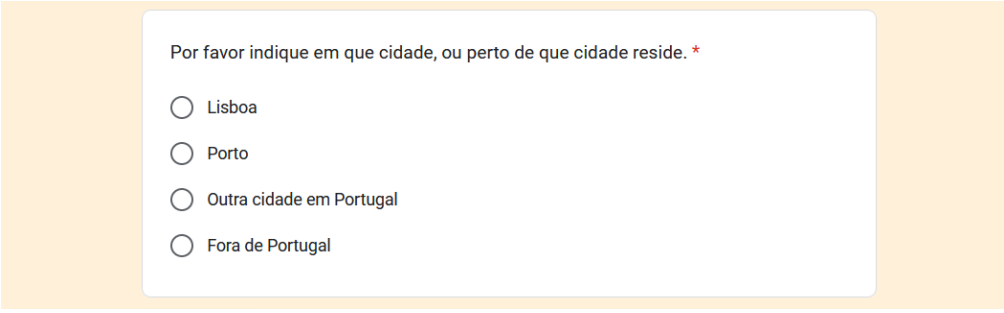
Z value Skewness	Z value Kurtosis		Z value Skewness	Z value Kurtosis
-1.88368	-1.133		-2.5026	0.536492
-3.2954	3.382288		-3.98671	4.0252
-1.91929	-0.69479		-4.79956	3.109231
-2.86448	0.13035		-3.39302	0.234022
-1.46679	0.564291		-4.48405	2.423839
-0.45159	1.345178		-3.46486	0.546344
-0.48456	0.941819		-2.45946	-0.27199
-0.40307	1.294387		-2.99907	0.428143
-0.68385	0.615447		-1.86746	-1.89943
-0.42123	-0.75868		-4.45073	3.654102
-0.97156	0.450565		-3.10512	1.267233
-1.40136	-0.72134		-2.99148	0.228589
-1.36716	0.530098		-0.68326	-0.60298
-0.62586	0.105987		-2.82662	0.515505

Item 9.4 - Skewness and Kurtosis Test, Metro Transportation (own authorship)

ANNEX C – ONLINE SURVEY PASSENGERS



Item 9.5 - Survey Introduction (own authorship)



Item 9.6 - City of residence (own authorship)

Tem experiência como passageiro/a nos Transportes Públicos de Lisboa? *

- ◯ Sim
- ◯ Não

Item 9.7 - Experience with transportation in Lisbon (own authorship)

Tendo em conta os seguintes meios de Transporte Público, por favor indique qual utiliza com mais frequência *

- ◯ Autocarro
- ◯ Metro

Item 9.8 - Transportation method (own authorship)

Autocarro

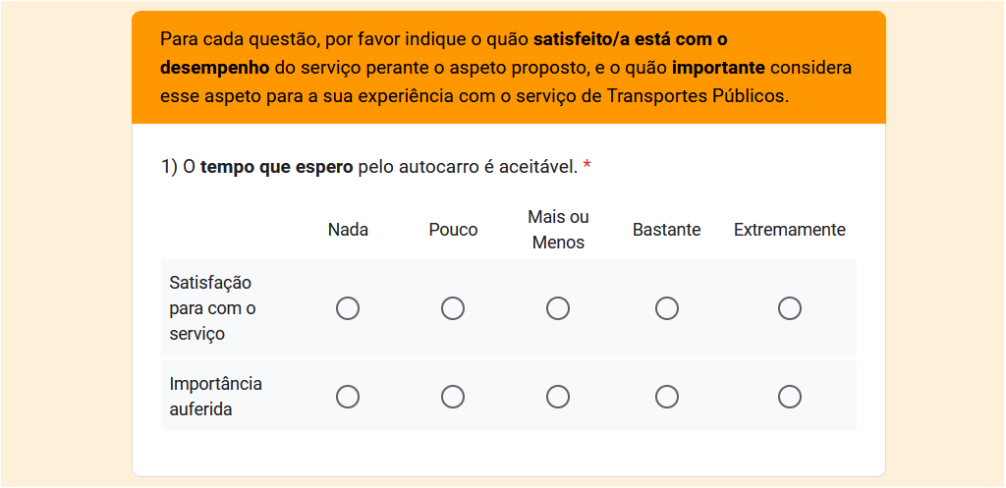
Com que frequência utiliza este meio de transporte? *

- ◯ Mais de 5 vezes por semana
- ◯ Entre 3 a 4 vezes por semana
- ◯ 1 a 2 vezes por semana
- ◯ Raramente

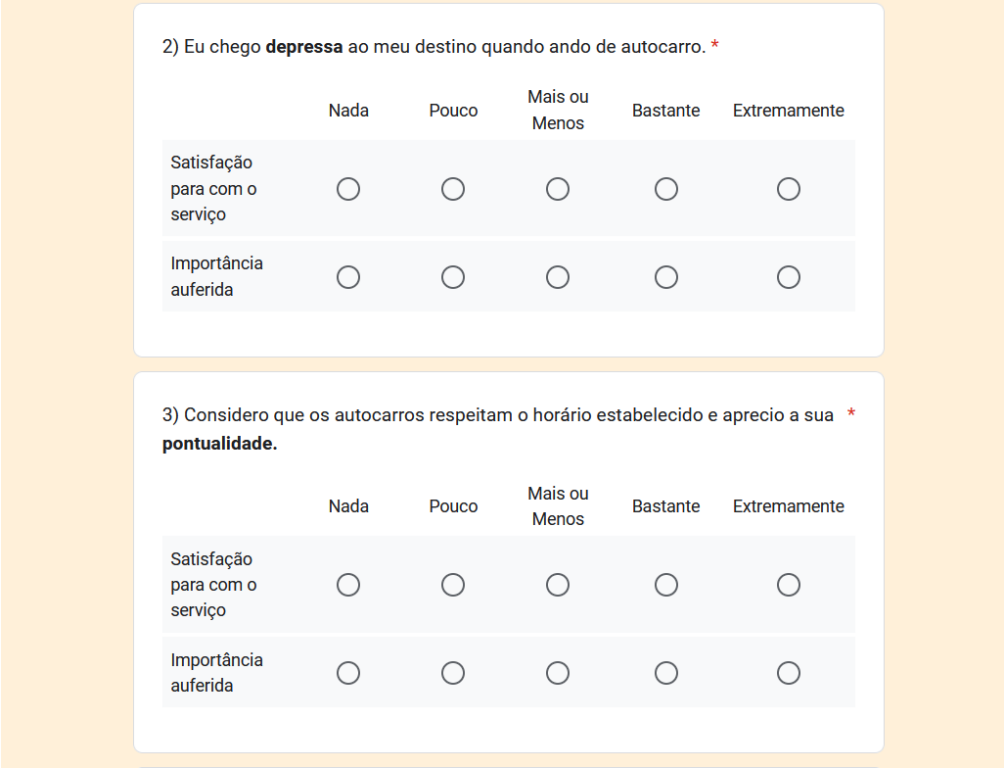
Qual é o principal propósito da utilização do transporte? *

- ◯ Trabalho
- ◯ Educação
- ◯ Lazer
- ◯ Compras ou outras necessidades

Item 9.9 - Bus (own authorship)

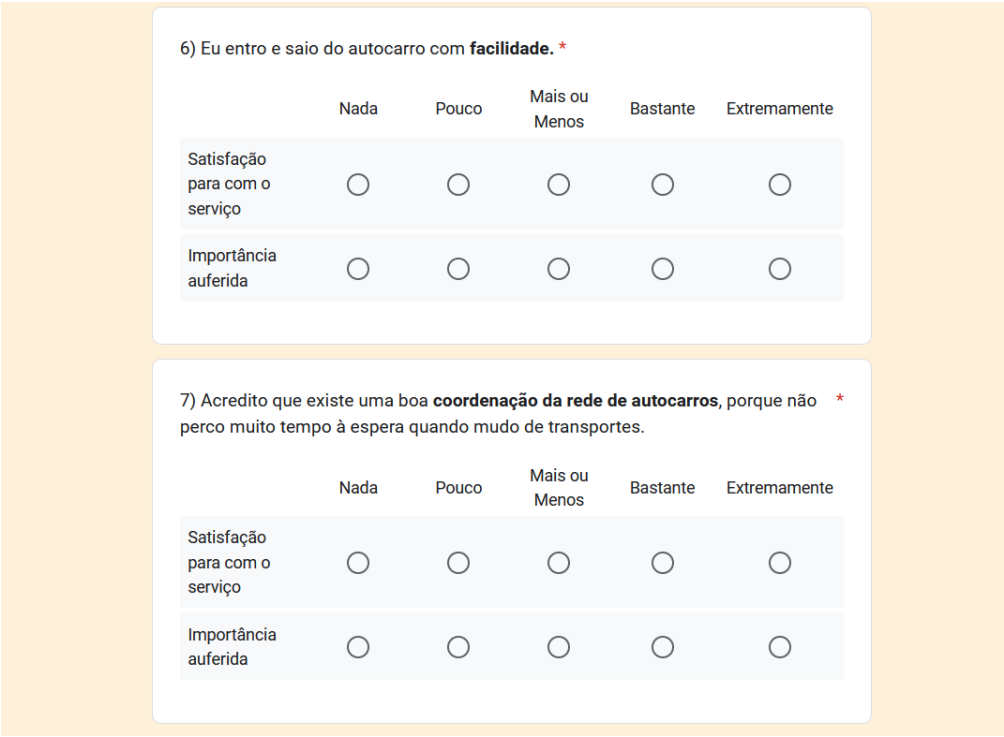


Item 9.10 - Bus (own authorship)

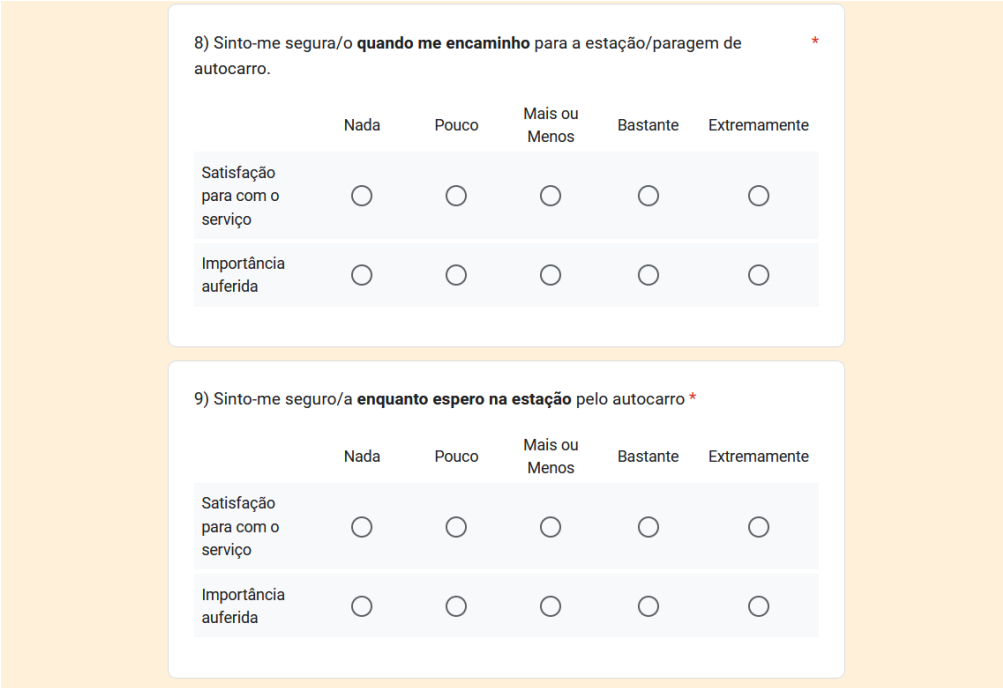


Item 9.11 - Bus (own authorship)

Item 9.12 - Bus (own authorship)



Item 9.13 - Bus (own authorship)



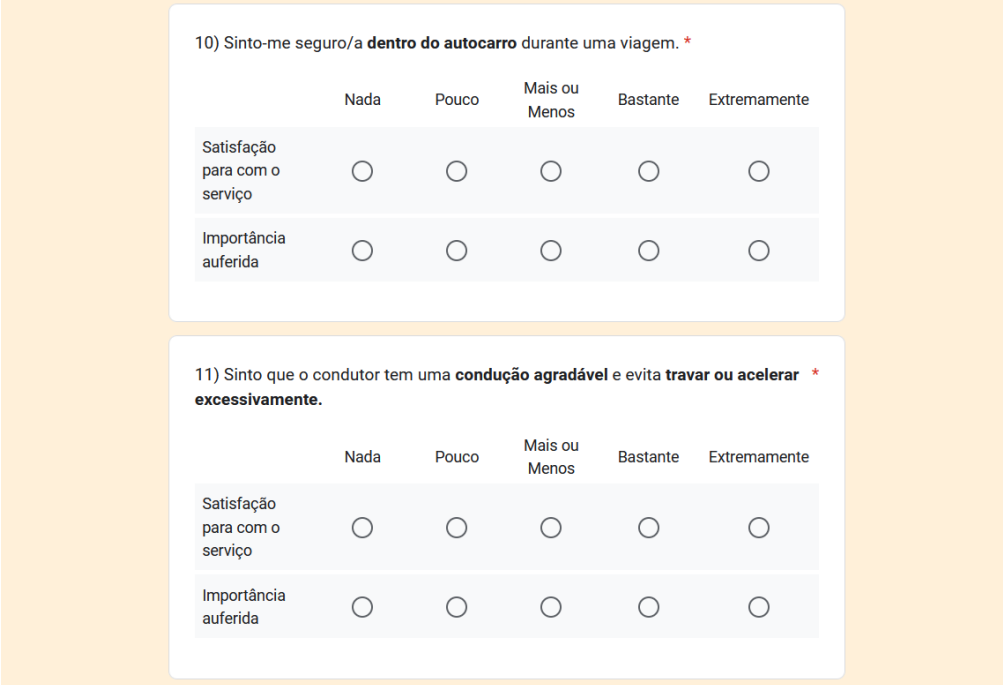
8) Sinto-me segura/o **quando me encaminho** para a estação/paragem de autocarro. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

9) Sinto-me seguro/a **enquanto espero na estação** pelo autocarro *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.14 - Bus (own authorship)



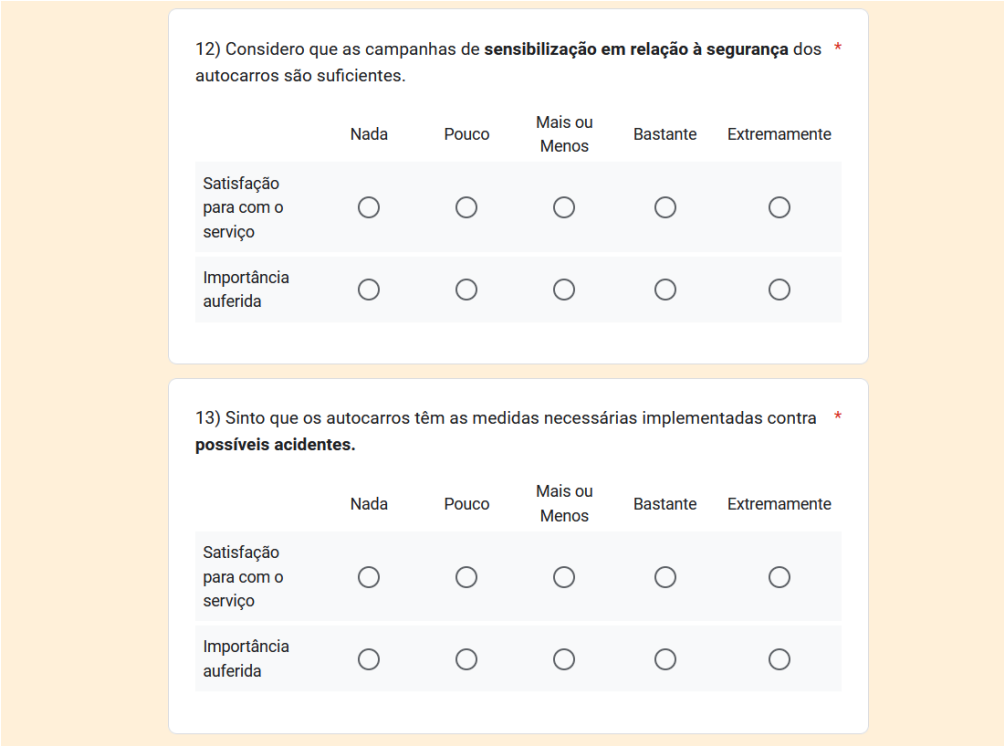
10) Sinto-me seguro/a **dentro do autocarro** durante uma viagem. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

11) Sinto que o condutor tem uma **condução agradável** e evita **travar ou acelerar excessivamente.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.15 -Bus (own authorship)



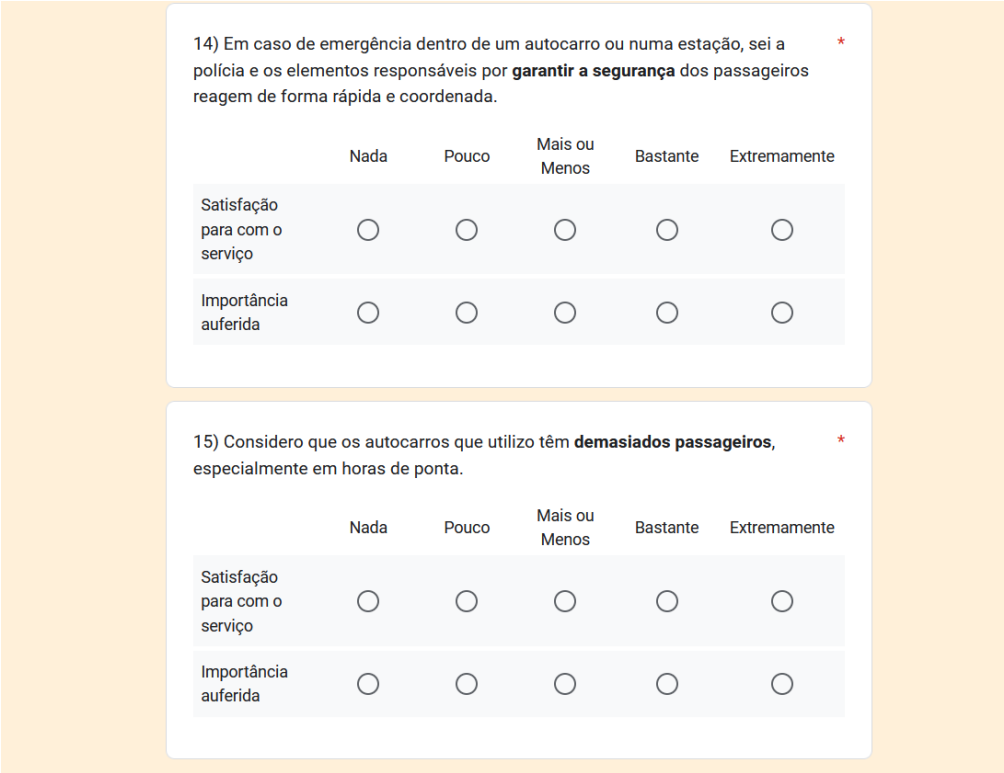
12) Considero que as campanhas de **sensibilização em relação à segurança** dos autocarros são suficientes. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

13) Sinto que os autocarros têm as medidas necessárias implementadas contra **possíveis acidentes.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.16 - Bus (own authorship)



14) Em caso de emergência dentro de um autocarro ou numa estação, sei a polícia e os elementos responsáveis por **garantir a segurança** dos passageiros reagem de forma rápida e coordenada. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

15) Considero que os autocarros que utilizo têm **demasiados passageiros**, especialmente em horas de ponta. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.17 - Bus (own authorship)

16) Sinto que os condutores de autocarro têm uma **boa atitude** perante mim. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

17) Considero que a **iluminação** nas estações e paragens de autocarro é a correta. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.18 - Bus (own authorship)

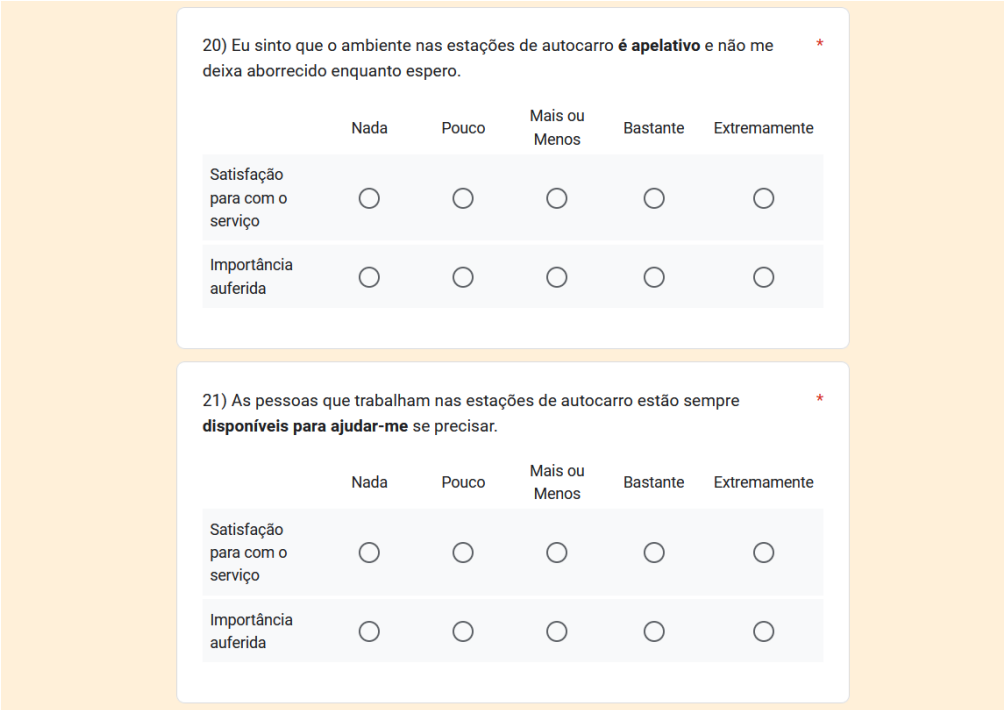
18) Considero que o ambiente das paragens e estações de autocarro é **limpo e confortável.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

19) Considero que os autocarros têm um aspeto **novo e apelativo.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.19 - Bus (own authorship)



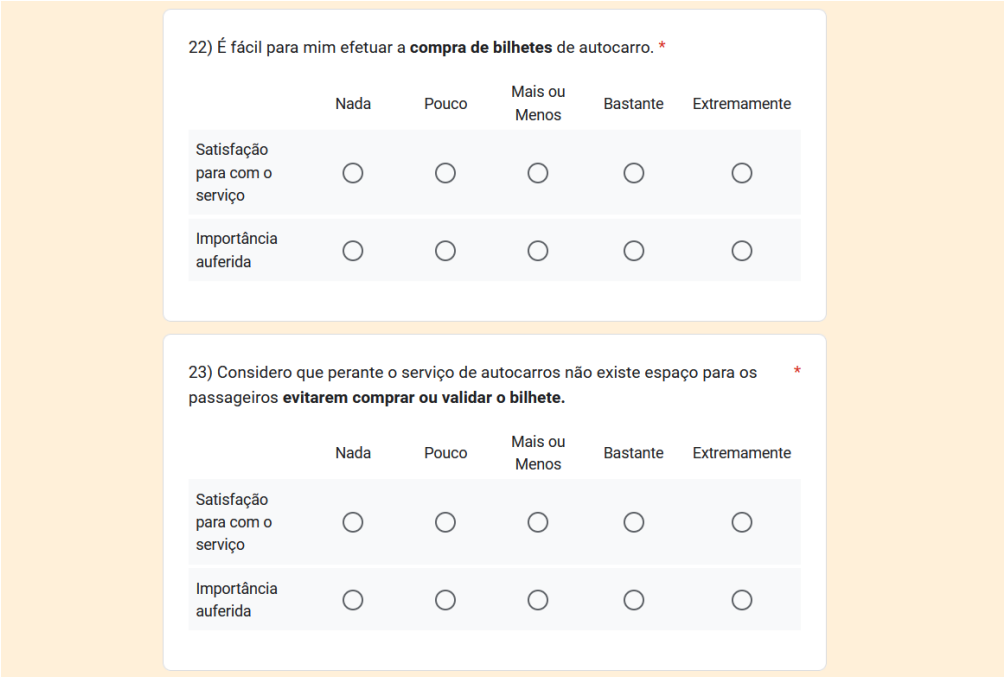
20) Eu sinto que o ambiente nas estações de autocarro **é apelativo** e não me deixa aborrecido enquanto espero. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

21) As pessoas que trabalham nas estações de autocarro estão sempre **disponíveis para ajudar-me** se precisar. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.20 - Bus (own authorship)



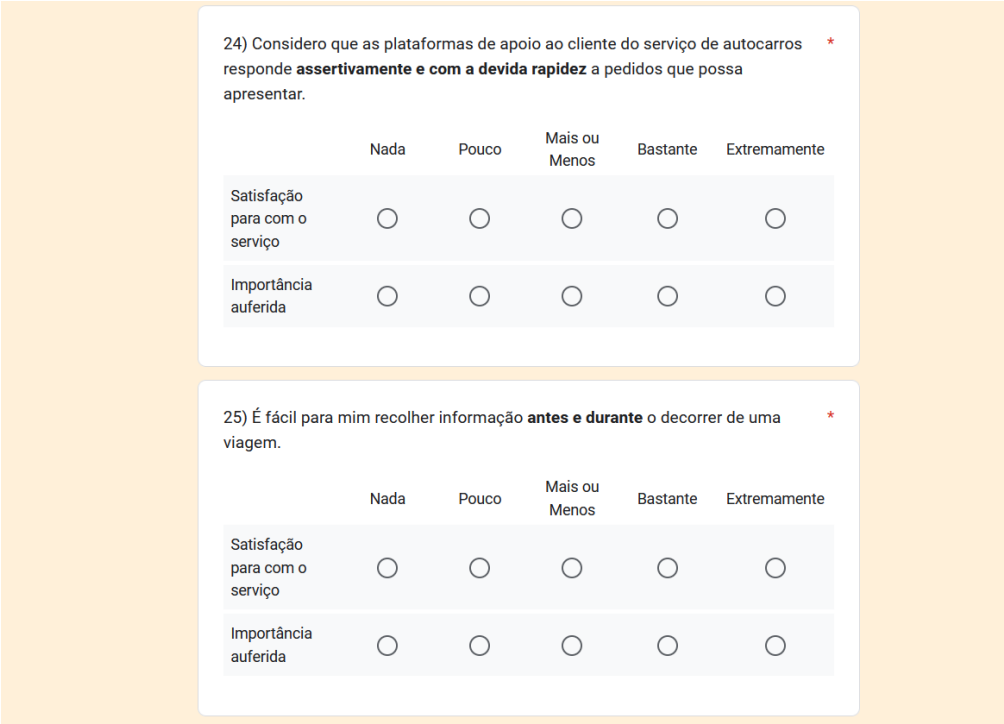
22) É fácil para mim efetuar a **compra de bilhetes** de autocarro. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

23) Considero que perante o serviço de autocarros não existe espaço para os passageiros **evitarem comprar ou validar o bilhete.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.21 - Bus (own authorship)



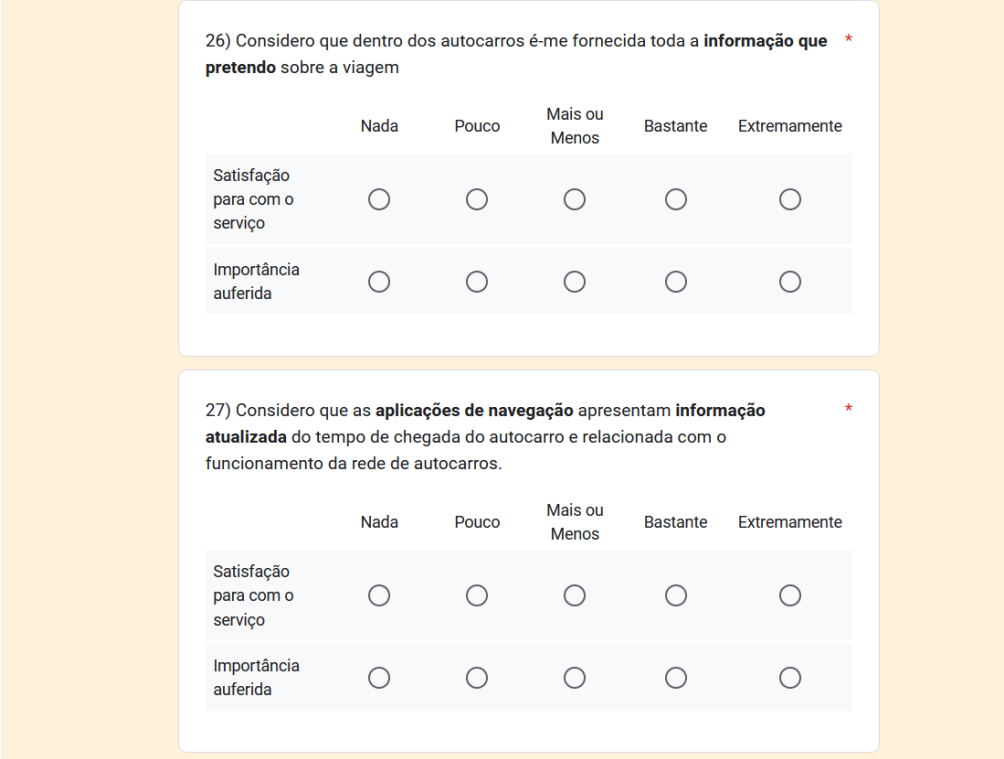
24) Considero que as plataformas de apoio ao cliente do serviço de autocarros responde **assertivamente e com a devida rapidez** a pedidos que possa apresentar. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

25) É fácil para mim recolher informação **antes e durante** o decorrer de uma viagem. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.22 - Bus (own authorship)



26) Considero que dentro dos autocarros é-me fornecida toda a **informação que pretendo** sobre a viagem *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

27) Considero que as **aplicações de navegação** apresentam **informação atualizada** do tempo de chegada do autocarro e relacionada com o funcionamento da rede de autocarros. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.23 - Bus (own authorship)

28) Quando existe um problema técnico ou operacional, a informação é-me transmitida **nas estações de autocarro** de forma imediata e bem visível. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Voltar Próxima Limpar formulário

Item 9.24 - Bus (own authorship)

Implementação de medidas nos serviços de transporte público

1) Com a automatização dos transportes públicos em várias capitais mundiais, foi possível alcançar um melhor desempenho no que toca à frequência de metros, elétricos e comboios, sendo que o mesmo se projeta para autocarros. Defina o quão benéfico seria a implementação de medidas tecnológicas que visam **reduzir o tempo de espera** entre cada autocarro e metro. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.25 - Improvements of transportation services (own authorship)

2) A automatização do serviço do metro permite a definição de pontos específicos de entrada e saída das carruagens. Defina o quão benéfico considera saber previamente à chegada do Metro, os pontos de **entrada/saída das carruagens** ao longo da linha. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.26 - Improvements of transportation services (own authorship)

3) A implementação de software mais robusto ou da automatização do serviço, tem como intuito a **redução da frequência de erros técnicos e operacionais,** que condicionam o bom funcionamento de uma linha de Metro ou rota de autocarro, gerando atrasos ou supressões. Defina o quão benéfico considera esta medida. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.27 - Improvements of transportation services (own authorship)

4) Em diversas cidades europeias, é possível verificar a **localização atual e estimativa atualizada de chegada** de qualquer transporte que pretendemos apanhar. Em Lisboa esta informação está indisponível para os autocarros e apenas existe atualização de horário para o metro, sem existir localização. Indique o quão benéfico considera ter acesso a este tipo de informação. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

5) Defina o quão benéfico é proceder à implementação de medidas tecnológicas que visam a **redução do consumo energético** dos transportes de Metro e Autocarro. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.28 - Improvements of transportation services (own authorship)

6) Considerando as aplicações de navegação disponíveis, indique o benefício de poder visualizar uma estimativa do **peso ecológico** de cada uma das diferentes alternativas de viagem propostas. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.29 - Improvements of transportation services (own authorship)

7) **A avaliação do serviço e recomendações após utilização** por parte de utilizadores são uma boa fonte de informação para o desenho e operação de serviços com qualidade. É possível avaliar os transportes em diversas categorias, como mostra a imagem, no entanto o utilizador nunca saberá de que forma as suas avaliações têm vindo a melhorar a qualidade dos serviços. De que maneira considera benéfico existir uma maior atenção em partilhar com o passageiro os contributos que as suas avaliações trouxeram. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.30 - Improvements of transportation services (own authorship)

8) Em cidades como Barcelona e Malmö, foi introduzida a **projeção de conteúdo informativo e didático** nas estações e dentro dos transportes. É possível visualizar notícias, informações do interesse comum, ou conteúdo para apreciação. Quão benéfico considera a implementação desta medida? *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.31 - Improvements of transportation services (own authorship)

9) Certas cidades europeias têm procurado simplificar o processo de **compra e validação de bilhetes de transporte público.** Em Copenhaga, uma vez que não possui torniquetes, é possível adquirir um bilhete virtual previamente, e caso seja pedido, é mostrado ao operador responsável pelo transporte. Consideraria esta medida como benéfica para os transportes em Lisboa? *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.32 - Improvements of transportation services (own authorship)

10) Plataformas como a O-CITY têm vindo a implementar a possibilidade de efetuar a **compra e gestão de bilhetes para todos os meios de transporte público** das cidades dentro da mesma aplicação móvel. Indique o quão benéfico considera esta implementação. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

Item 9.33 - Improvements of transportation services (own authorship)

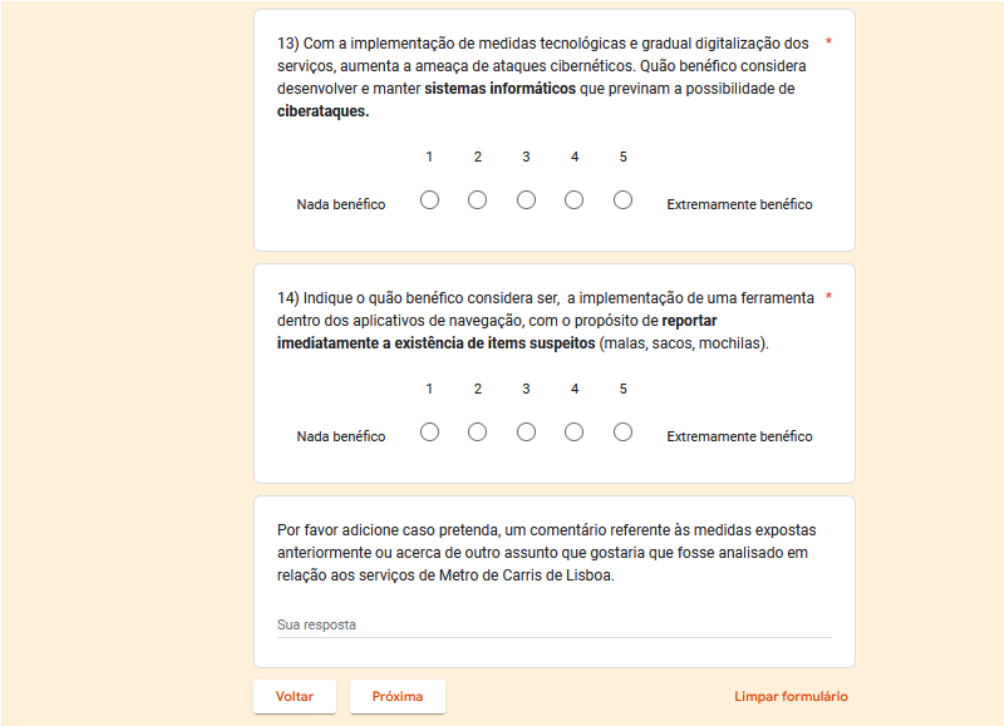
11) Considerando a experiência do passageiro, quão benéfico consideraria a implementação de medidas tecnológicas que visem a **diminuição de risco de atropelamento** rodoviário e de **quedas de pessoas e objetos** para as linhas de Metro. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

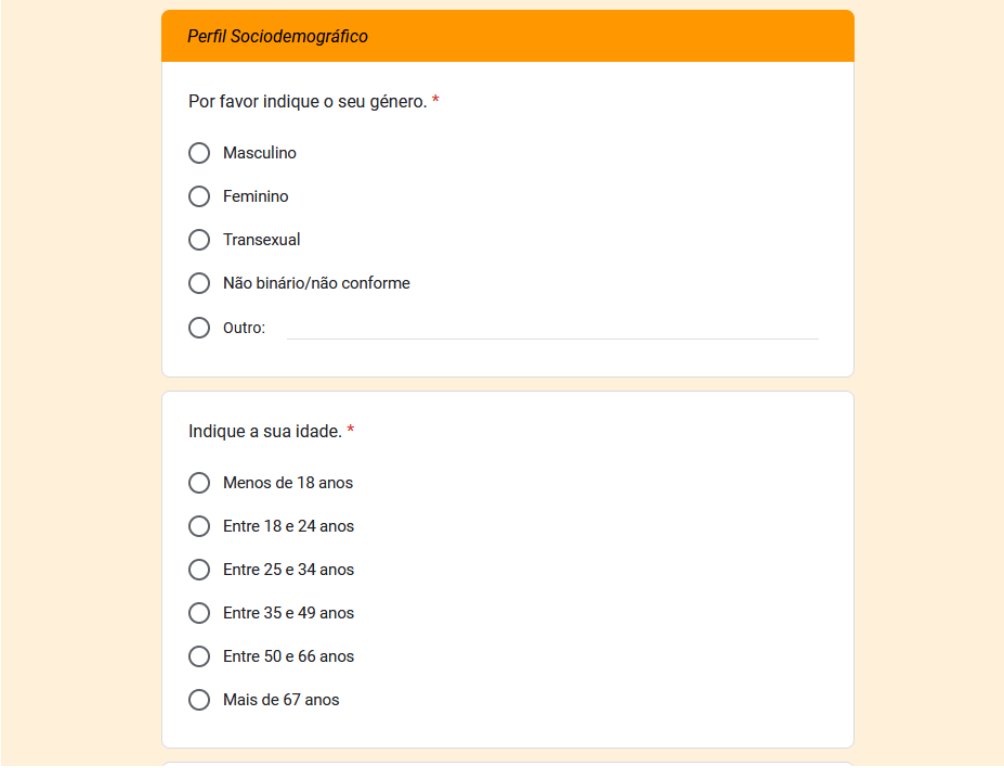
12) Na cidade de Nova Iorque, EUA, existe um aplicativo independente onde é possível analisar e receber **alertas de incidentes** que estão a ocorrer ao vivo pela cidade, devido à partilha de vídeo e mensagens entre cidadãos. Avalie o benefício que considera ter, a adaptação deste serviço para áreas perto de paragens e estações em Lisboa. *

	1	2	3	4	5	
Nada benéfico	○	○	○	○	○	Extremamente benéfico

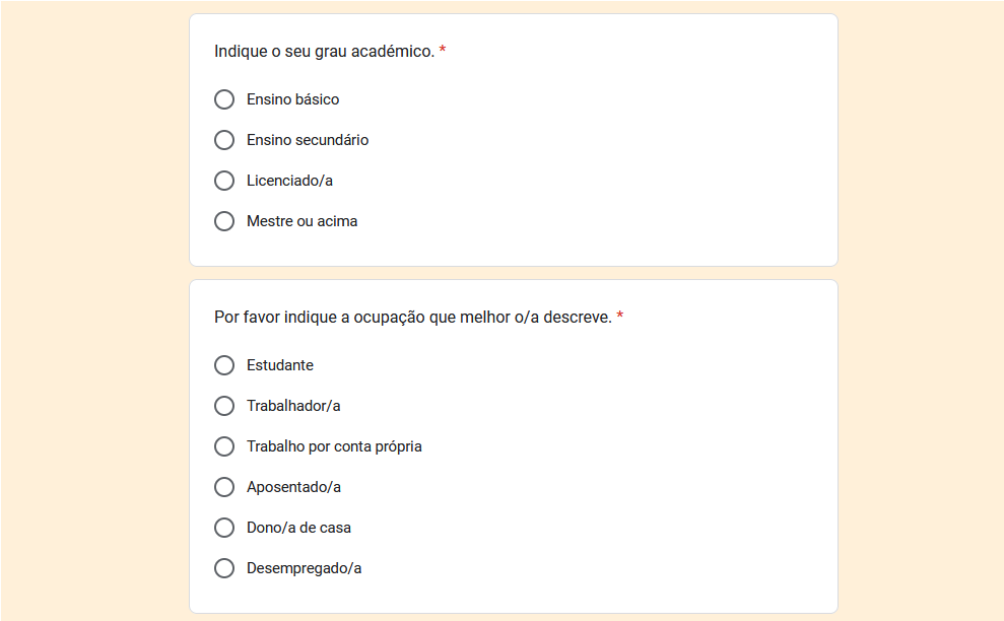
Item 9.34 - Improvements of transportation services (own authorship)



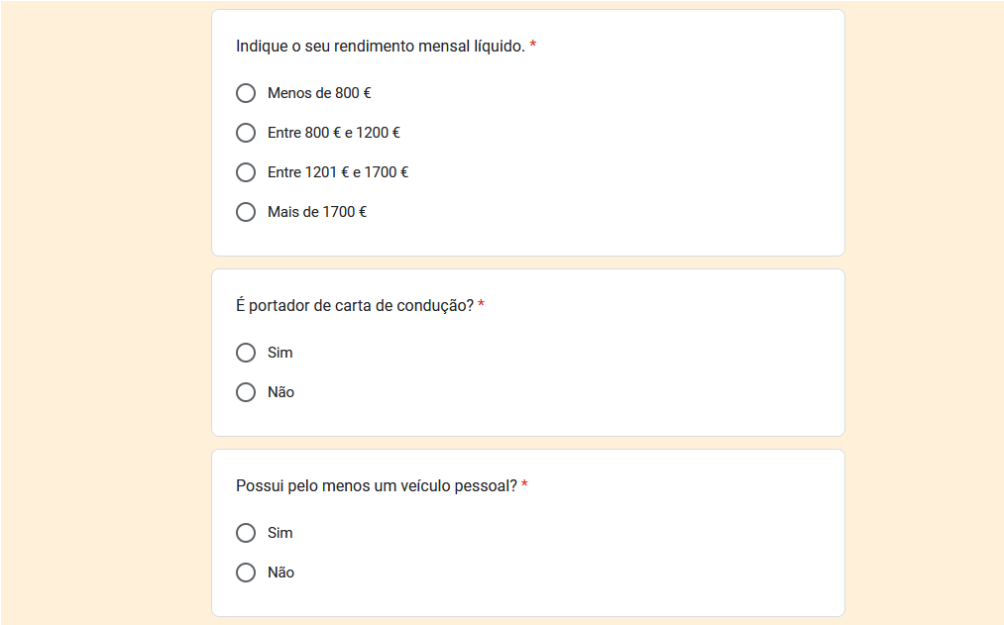
Item 9.35 - Improvements of transportation services (own authorship)



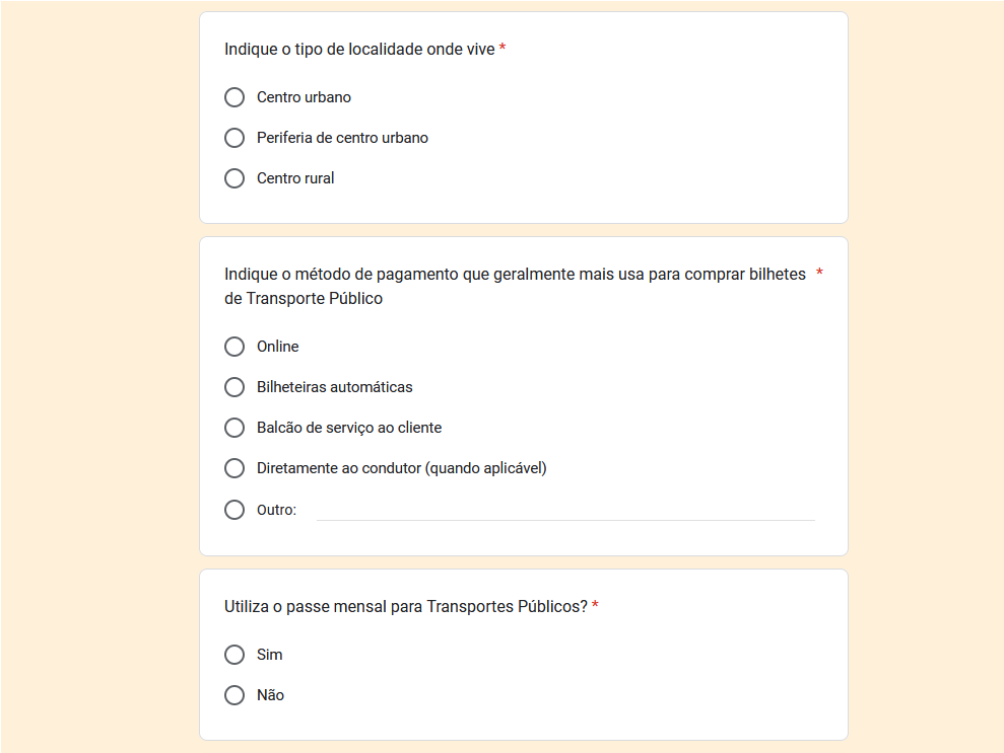
Item 9.36 - Survey respondents (own authorship)



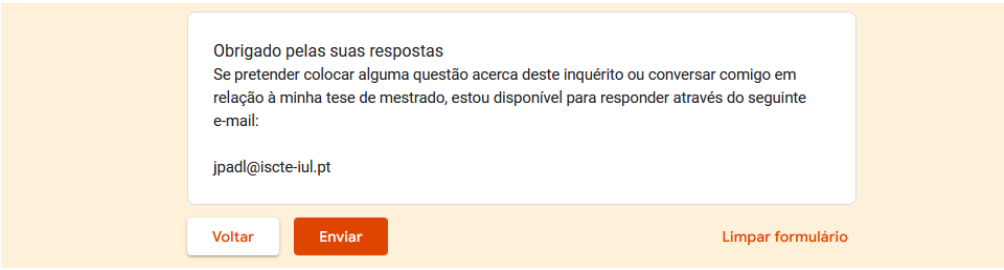
Item 9.37 - Survey respondents (own authorship)



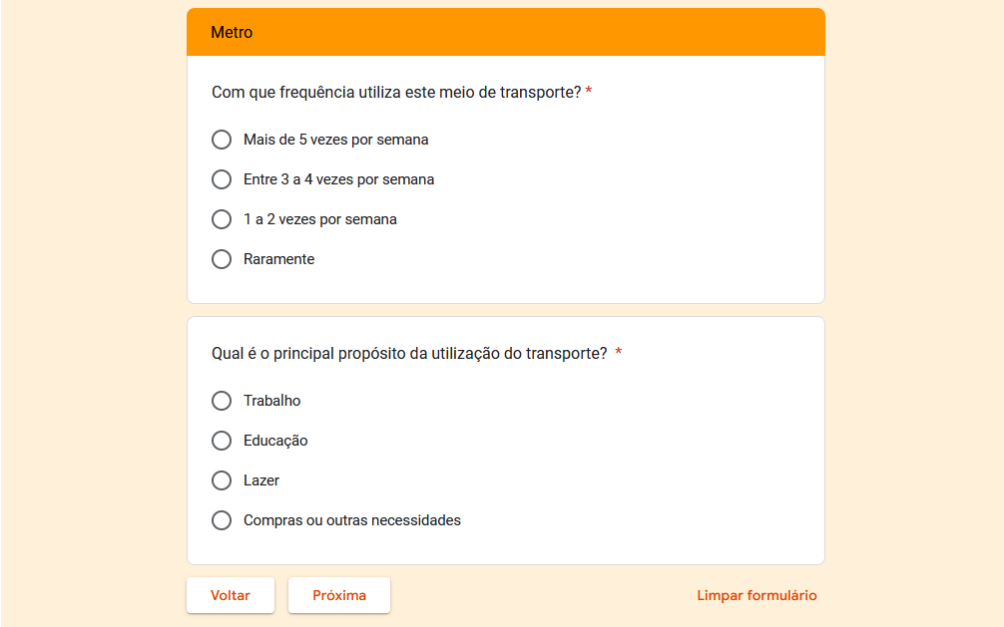
Item 9.38 - Survey respondents (own authorship)



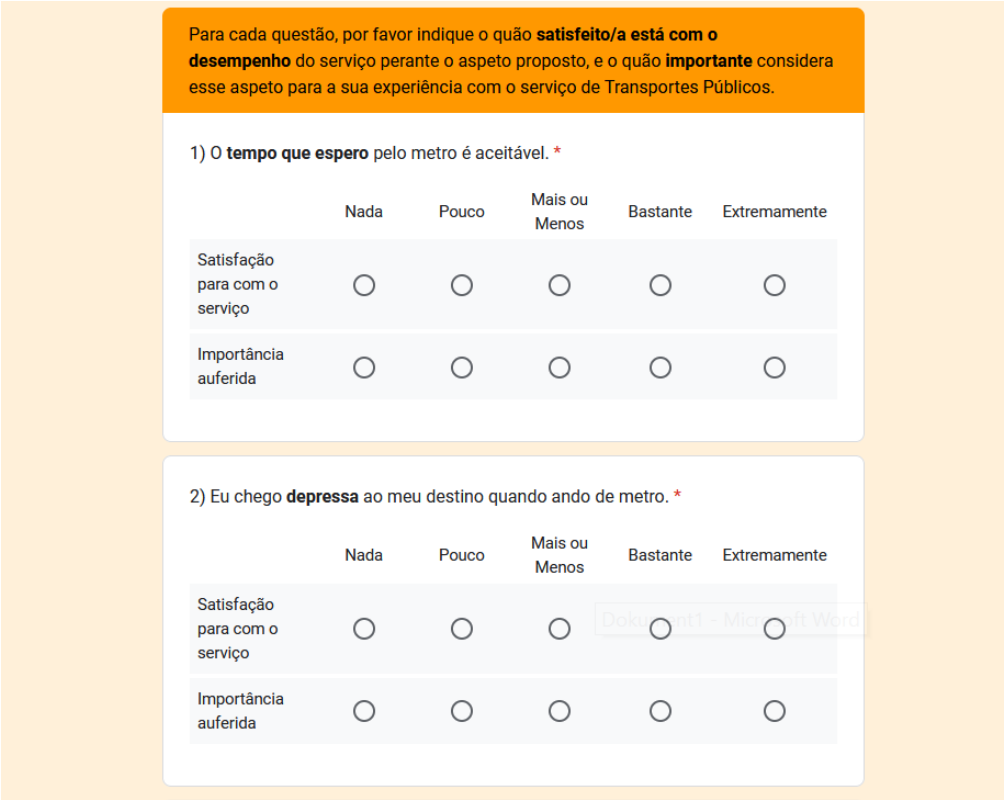
Item 9.39 - Survey respondents (own authorship)



Item 9.40 - Survey respondents (own authorship)



Item 9.41 - Metro (own authorship)



Para cada questão, por favor indique o quão **satisfeito/a está com o desempenho** do serviço perante o aspeto proposto, e o quão **importante** considera esse aspeto para a sua experiência com o serviço de Transportes Públicos.

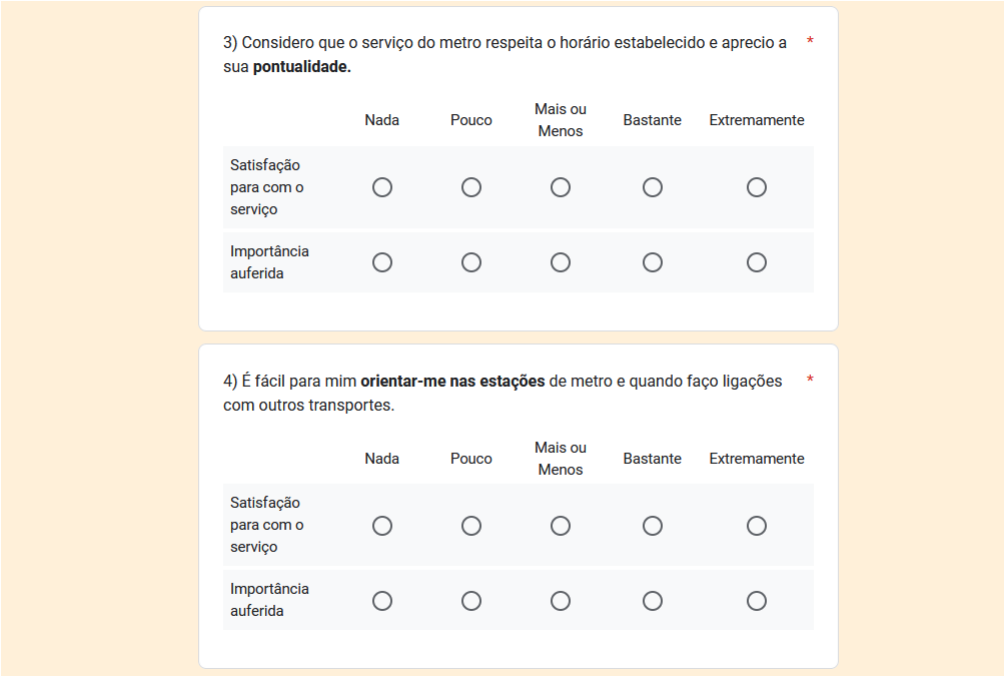
1) O **tempo que espero** pelo metro é aceitável. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

2) Eu chego **depressa** ao meu destino quando ando de metro. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.42 - Metro (own authorship)



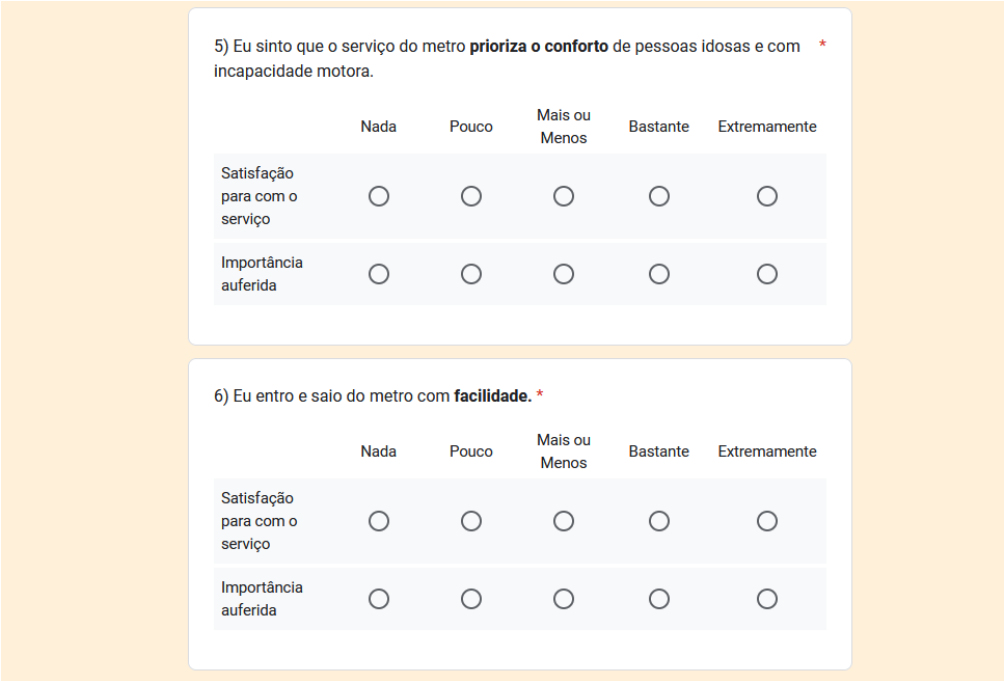
3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua **pontualidade.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

4) É fácil para mim **orientar-me nas estações** de metro e quando faço ligações com outros transportes. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.43 - Metro (own authorship)



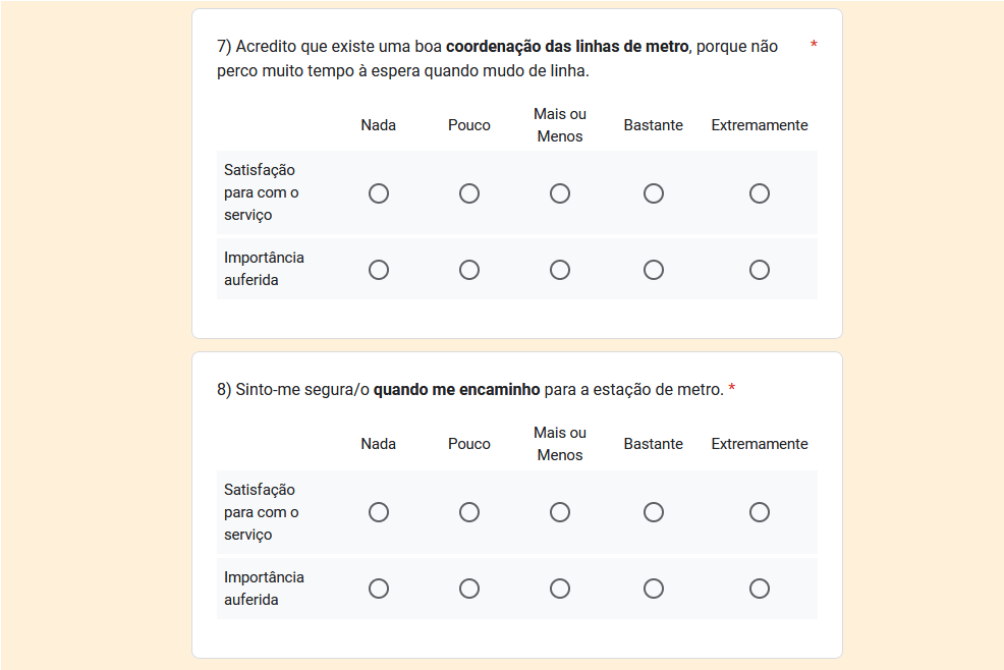
5) Eu sinto que o serviço do metro **prioriza o conforto** de pessoas idosas e com incapacidade motora. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

6) Eu entro e saio do metro com **facilidade.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.44 - Metro (own authorship)



7) Acredito que existe uma boa **coordenação das linhas de metro**, porque não perco muito tempo à espera quando mudo de linha. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

8) Sinto-me segura/o **quando me encaminho** para a estação de metro. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.45 - Metro (own authorship)

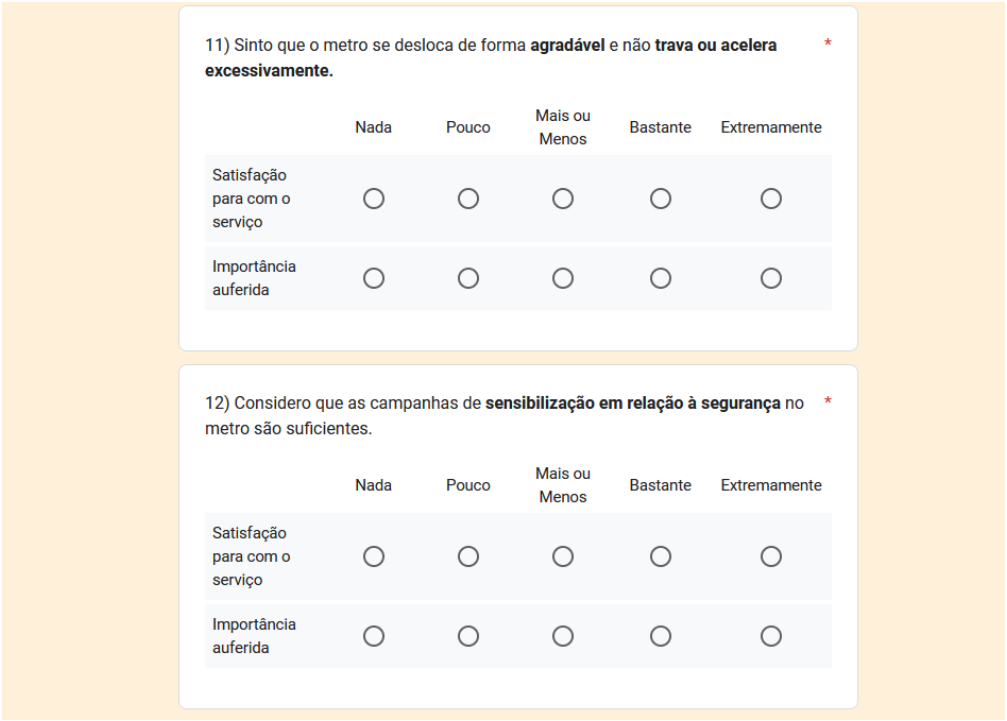
9) Sinto-me seguro/a **enquanto espero na estação** de metro. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

10) Sinto-me seguro/a **dentro do metro** durante uma viagem. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.46 - Metro (own authorship)



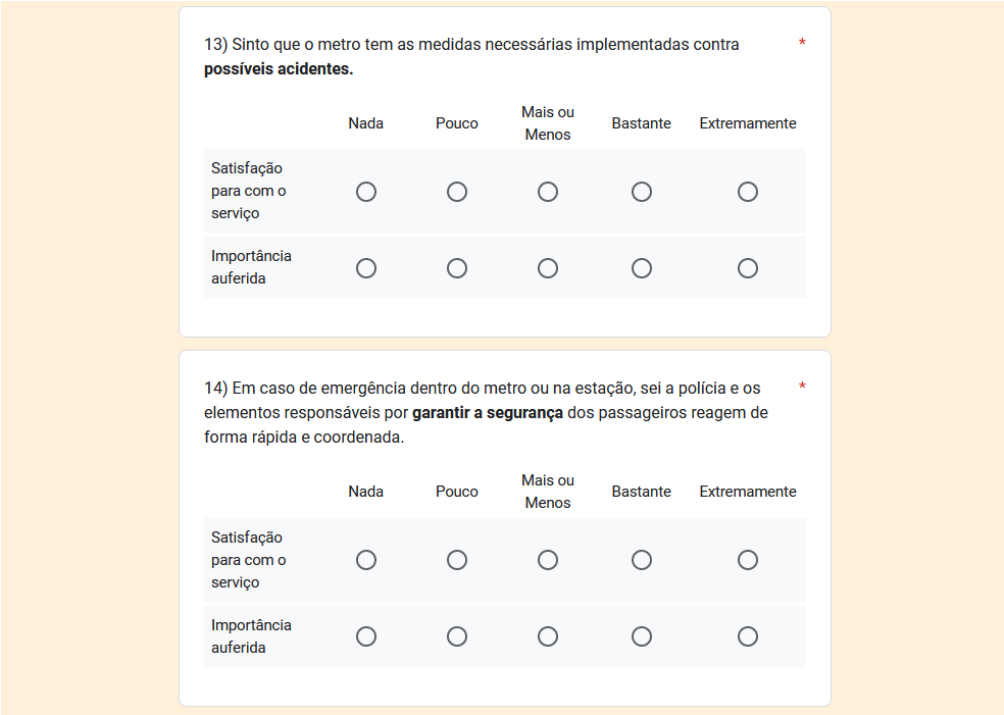
11) Sinto que o metro se desloca de forma **agradável** e não **trava ou acelera excessivamente.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

12) Considero que as campanhas de **sensibilização em relação à segurança** no metro são suficientes. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.47 - Metro (own authorship)



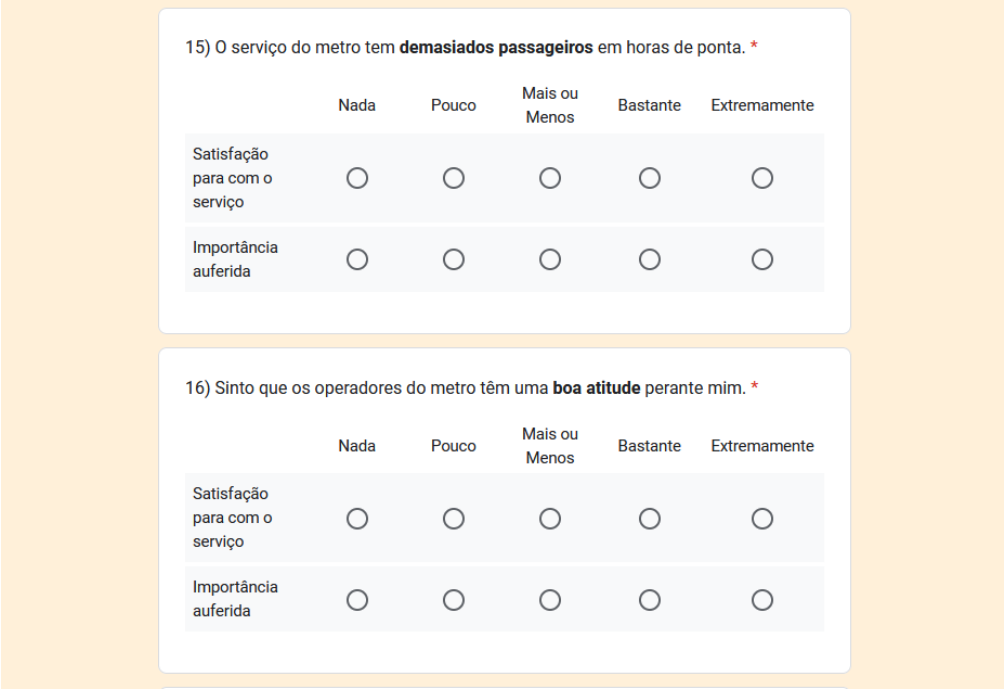
13) Sinto que o metro tem as medidas necessárias implementadas contra **possíveis acidentes.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

14) Em caso de emergência dentro do metro ou na estação, sei a polícia e os elementos responsáveis por **garantir a segurança** dos passageiros reagem de forma rápida e coordenada. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.48 - Metro (own authorship)



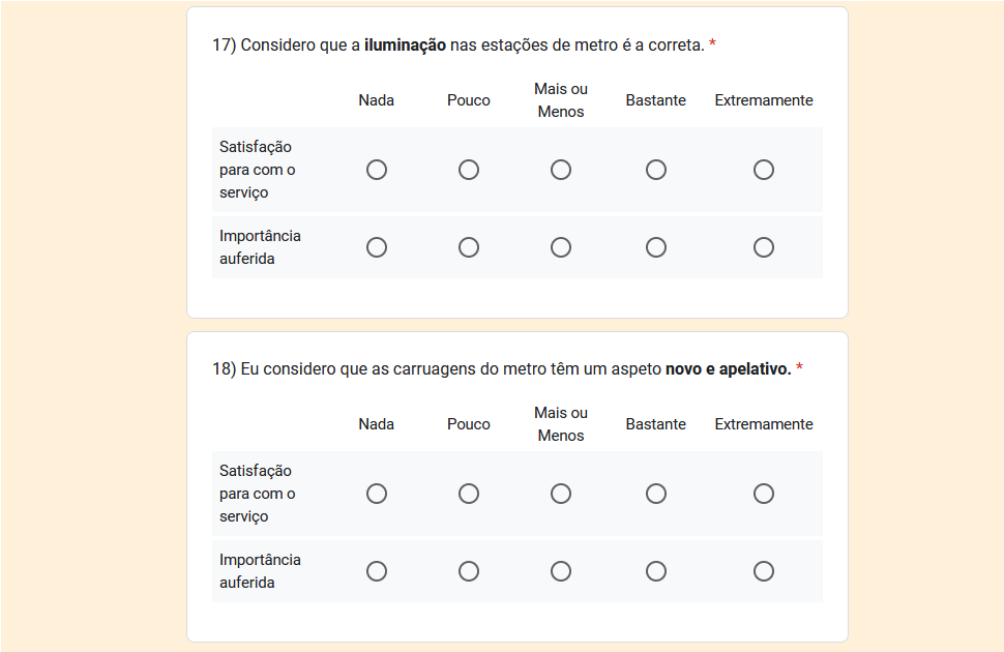
15) O serviço do metro tem **demasiados passageiros** em horas de ponta. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

16) Sinto que os operadores do metro têm uma **boa atitude** perante mim. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.49 - Metro (own authorship)



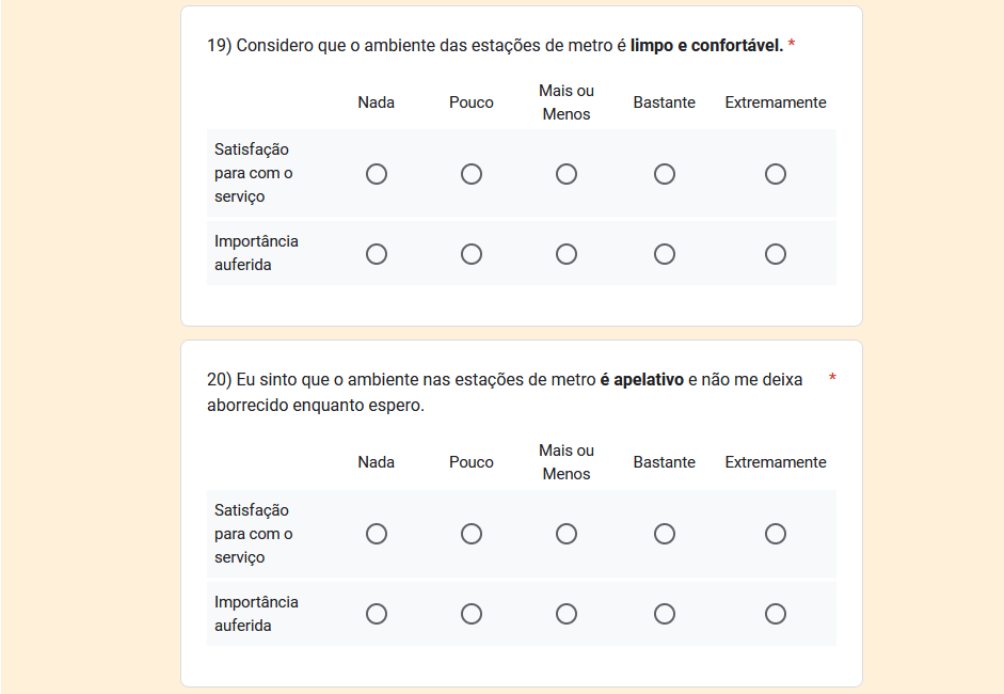
17) Considero que a **iluminação** nas estações de metro é a correta. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

18) Eu considero que as carruagens do metro têm um aspeto **novo e apelativo.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.50 - Metro (own authorship)



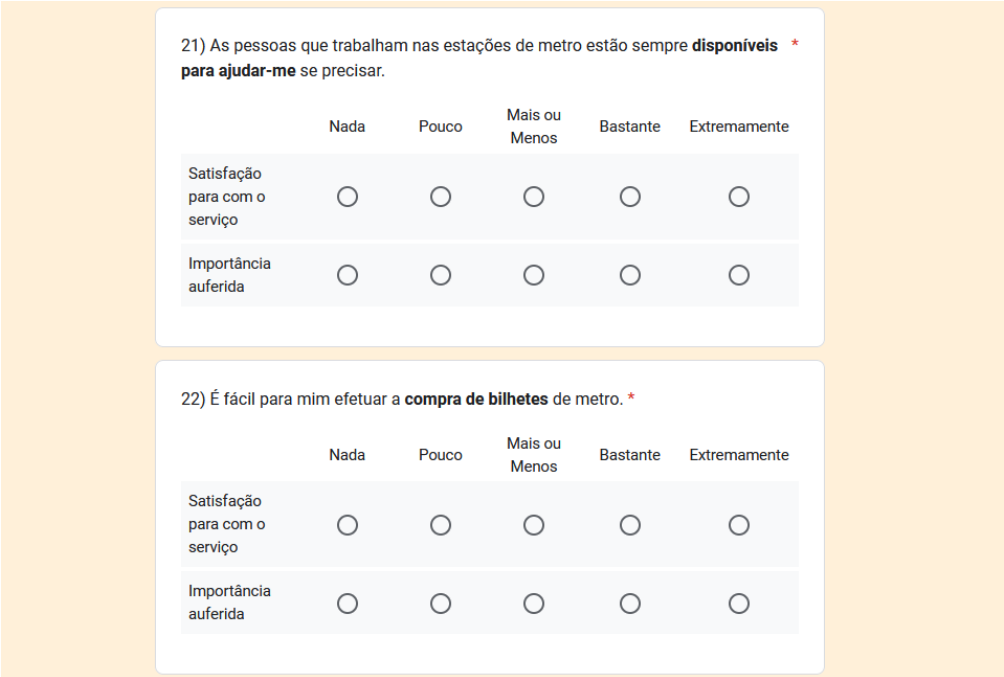
19) Considero que o ambiente das estações de metro é **limpo e confortável.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

20) Eu sinto que o ambiente nas estações de metro **é apelativo** e não me deixa aborrecido enquanto espero. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.51 - Metro (own authorship)



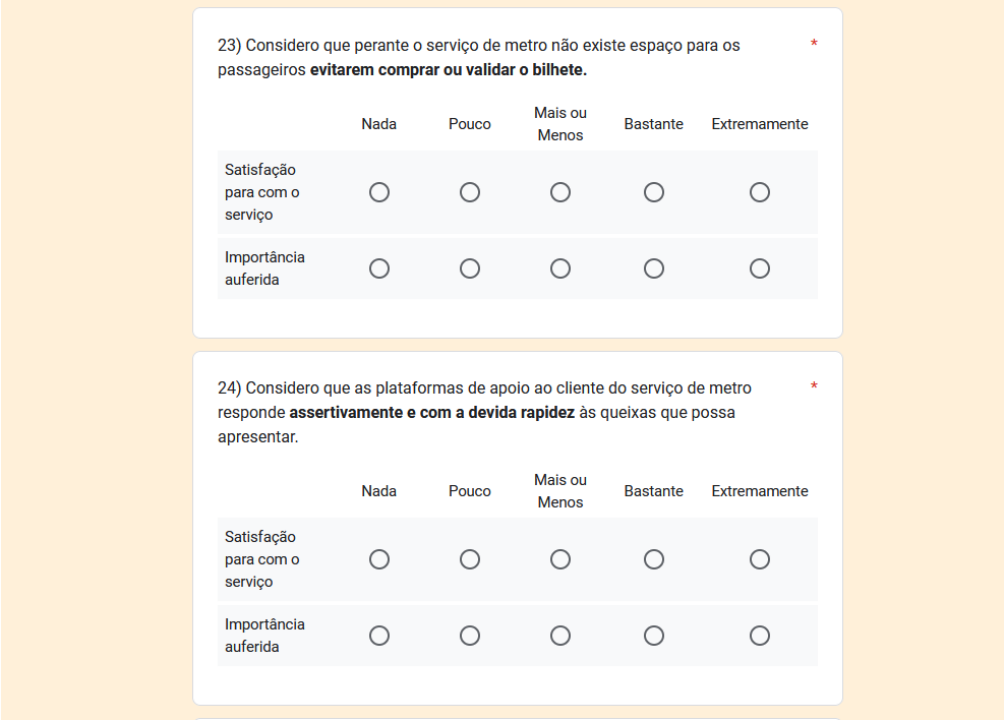
21) As pessoas que trabalham nas estações de metro estão sempre **disponíveis para ajudar-me** se precisar. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

22) É fácil para mim efetuar a **compra de bilhetes** de metro. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.52 - Metro (own authorship)



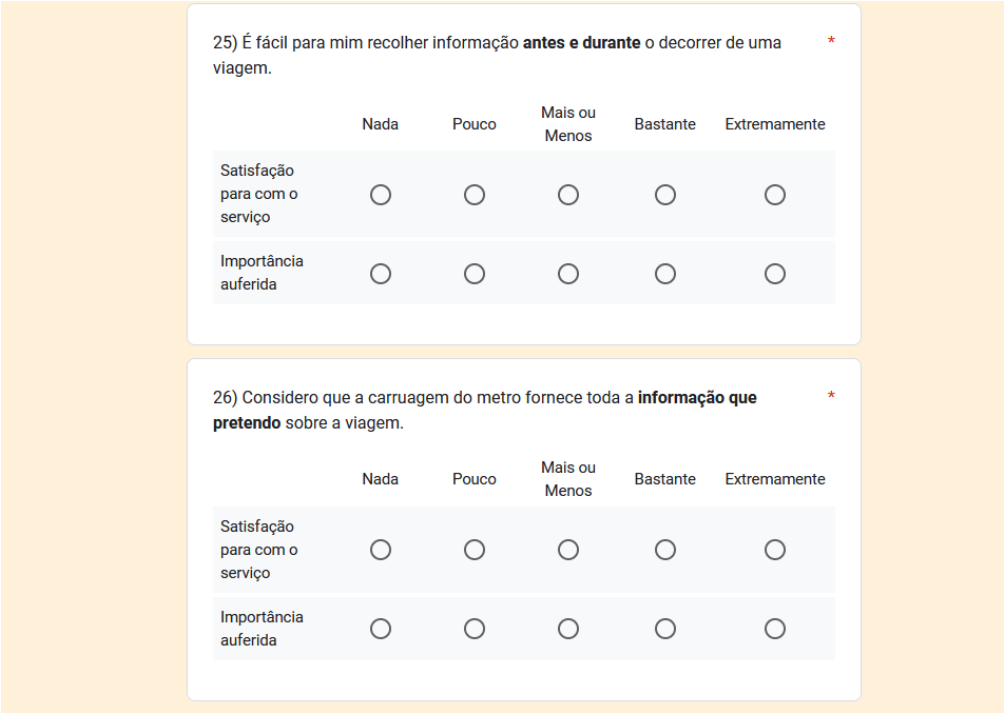
23) Considero que perante o serviço de metro não existe espaço para os passageiros **evitarem comprar ou validar o bilhete.** *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

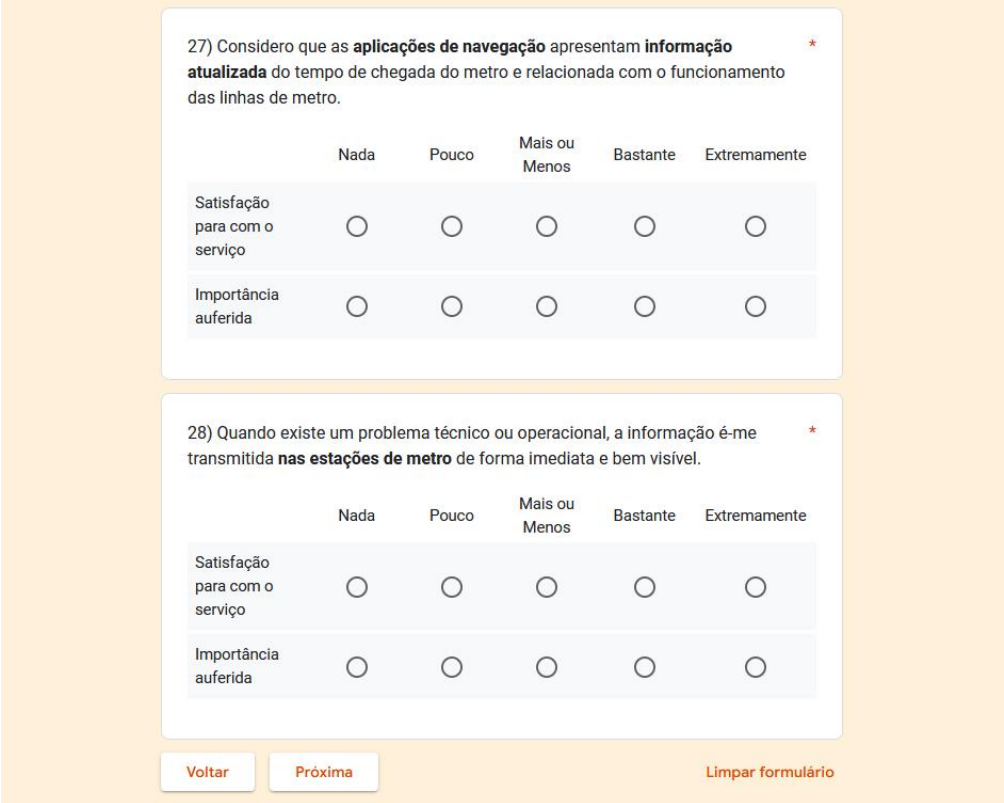
24) Considero que as plataformas de apoio ao cliente do serviço de metro responde **assertivamente e com a devida rapidez** às queixas que possa apresentar. *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Satisfação para com o serviço	○	○	○	○	○
Importância auferida	○	○	○	○	○

Item 9.53 - Metro (own authorship)



Item 9.54 - Metro (own authorship)



Item 9.55 - Metro (own authorship)

ANNEX D – RELIABILITY AND VALIDITY

Bus performance test		
KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.758
Bartlett's Test of Sphericity	Approx. Chi-Square	426.072
	df	78
	Sig.	0

Item 9.56 - KMO and Bartlett's Test, Bus Transportation (own authorship)

Communalities	Initial	Extraction
1) O tempo que espero pelo autocarro é aceitável.	1,000	0.771
3) Considero que os autocarros respeitam o horário estabelecido e aprecio a sua pontualidade.	1,000	0.694
9) Sinto-me seguro/a enquanto espero na estação pelo autocarro.	1,000	0.659
10) Sinto-me seguro/a dentro do autocarro durante uma viagem.	1,000	0.696
21) As pessoas que trabalham nas estações de autocarro estão sempre disponíveis para ajudar-me se precisar.	1,000	0.769
22) É fácil para mim efetuar a compra de bilhetes de autocarro.	1,000	0.568
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do autocarro e relacionada com o funcionamento da rede de autocarros.	1,000	0.582
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de autocarro de forma imediata e bem visível.	1,000	0.67
25) É fácil para mim recolher informação antes e durante o decorrer de uma viagem.	1,000	0.771
16) Sinto que os condutores de autocarro têm uma boa atitude perante mim.	1,000	0.481
26) Considero que dentro dos autocarros é-me fornecida toda a informação que pretendo sobre a viagem.	1,000	0.633
4) É fácil para mim orientar-me nas estações de autocarro e quando faço ligações com outros transportes.	1,000	0.572
2) Eu chego depressa ao meu destino quando ando de autocarro.	1,000	0.603

Extraction Method: PCA

Item 9.57 - Principal Component Analysis Communalities, Performance, Bus Transportation (own authorship)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	4.173	32.102	32.102	4.173	32.102	32.102	2.332	17.938	17.938
2	1.922	14.784	46.885	1.922	14.784	46.885	2.271	17.467	35.405
3	1.336	10.275	57.16	1.336	10.275	57.16	2.163	16.637	52.042
4	1.036	7.966	65.126	1.036	7.966	65.126	1.701	13.084	65.126
5	0.849	6.531	71.658						
6	0.723	5.565	77.223						
7	0.604	4.648	81.871						
8	0.507	3.899	85.77						
9	0.483	3.714	89.484						
10	0.426	3.276	92.76						
11	0.378	2.911	95.671						
12	0.341	2.625	98.297						
13	0.221	1.703	100						

Extraction Method: PCA

Item 9.58 - Total Variance Explained, Bus Transportation (own authorship)

Rotated Component Matrix Performance	Component			
	1	2	3	4
21) As pessoas que trabalham nas estações de autocarro estão sempre disponíveis para ajudar-me se precisar.	0.784	0.361		
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de autocarro de forma imediata e bem visível.	0.783			
26) Considero que dentro dos autocarros é-me fornecida toda a informação que pretendo sobre a viagem.	0.728			0.255
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do autocarro e relacionada com o funcionamento da rede de autocarros.	0.607		0.405	
10) Sinto-me seguro/a dentro do autocarro durante uma viagem.		0.821		
9) Sinto-me seguro/a enquanto espero na estação pelo autocarro.		0.795		
16) Sinto que os condutores de autocarro têm uma boa atitude perante mim.		0.682		
1) O tempo que espero pelo autocarro é aceitável.			0.825	
3) Considero que os autocarros respeitam o horário estabelecido e aprecio a sua pontualidade.			0.783	
2) Eu chego depressa ao meu destino quando ando de autocarro.			0.755	
25) É fácil para mim recolher informação antes e durante o decorrer de uma viagem.				0.852
22) É fácil para mim efetuar a compra de bilhetes de autocarro.		0.316		0.635
4) É fácil para mim orientar-me nas estações de autocarro e quando faço ligações com outros transportes.		0.382		0.603
Extraction Method: PCA				
Rotation Method: Varimax with Kaiser Normalization a Rotation converged in 5 iterations.				

Item 9.59 - Principal Component Analysis with Varimax rotation, Bus Transportation (own authorship)

1

Reliability Statistics	
Cronbach's Alpha	N of Items
0.772	5

2

Reliability Statistics	
Cronbach's Alpha	N of Items
0.763	4

3

Reliability Statistics	
Cronbach's Alpha	N of Items
0.761	3

4

Reliability Statistics	
Cronbach's Alpha	N of Items
0.647	3

Item 9.60 - Cronbach's Alpha Reliability Test (own authorship)

Bus importance test		
KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.882
Bartlett's Test of Sphericity	Approx. Chi-Square	844.081
	df	78
	Sig.	0

Item 9.61 - KMO and Bartlett's Test, Bus Transportation (own authorship)

Communalities	Initial	Extraction
1) O tempo que espero pelo autocarro é aceitável.	1,000	0.848
2) Eu chego depressa ao meu destino quando ando de autocarro.	1,000	0.644
3) Considero que os autocarros respeitam o horário estabelecido e aprecio a sua pontualidade.	1,000	0.807
4) É fácil para mim orientar-me nas estações de autocarro e quando faço ligações com outros transportes.	1,000	0.842
9) Sinto-me seguro/a enquanto espero na estação pelo autocarro.	1,000	0.713
10) Sinto-me seguro/a dentro do autocarro durante uma viagem.	1,000	0.698
16) Sinto que os condutores de autocarro têm uma boa atitude perante mim.	1,000	0.653
21) As pessoas que trabalham nas estações de autocarro estão sempre disponíveis para ajudar-me se precisar.	1,000	0.812
22) É fácil para mim efetuar a compra de bilhetes de autocarro.	1,000	0.674
25) É fácil para mim recolher informação antes e durante o decorrer de uma viagem.	1,000	0.829
26) Considero que dentro dos autocarros é-me fornecida toda a informação que pretendo sobre a viagem.	1,000	0.803
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do autocarro e relacionada com o funcionamento da rede de autocarros.	1,000	0.81
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de autocarro de forma imediata e bem visível.	1,000	0.866

Extraction Method: PCA

Item 9.62 - Principal Component Analysis Communalities, Bus Transportation (own authorship)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	6.579	50.612	50.612	6.579	50.612	50.612	3.647	28.052	28.052
2	1.37	10.54	61.151	1.37	10.54	61.151	2.822	21.709	49.761
3	1.208	9.291	70.443	1.208	9.291	70.443	1.941	14.933	64.694
4	0.842	6.473	76.916	0.842	6.473	76.916	1.589	12.222	76.916
5	0.662	5.094	82.01						
6	0.536	4.124	86.134						
7	0.451	3.471	89.605						
8	0.324	2.493	92.098						
9	0.249	1.917	94.015						
10	0.225	1.733	95.748						
11	0.212	1.627	97.375						
12	0.182	1.397	98.773						
13	0.16	1.227	100						

Extraction Method: PCA

Item 9.63 - Total Variance Explained, Bus Transportation (own authorship)

Rotated Component Matrix Importance

	Component			
	1	2	3	4
1) O tempo que espero pelo autocarro é aceitável.	0.847	0.344		
3) Considero que os autocarros respeitam o horário estabelecido e aprecio a sua pontualidade.	0.794	0.296	0.297	
2) Eu chego depressa ao meu destino quando ando de autocarro.	0.751			
9) Sinto-me seguro/a enquanto espero na estação pelo autocarro.	0.706			0.377
10) Sinto-me seguro/a dentro do autocarro durante uma viagem.	0.686	0.298		0.364
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de autocarro de forma imediata e bem visível.	0.404	0.804		
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do autocarro e relacionada com o funcionamento da rede de autocarros.	0.446	0.778		
25) É fácil para mim recolher informação antes e durante o decorrer de uma viagem.		0.733	0.407	0.274
26) Considero que dentro dos autocarros é-me fornecida toda a informação que pretendo sobre a viagem.		0.697	0.307	0.471
21) As pessoas que trabalham nas estações de autocarro estão sempre disponíveis para ajudar-me se precisar.			0.861	
22) É fácil para mim efetuar a compra de bilhetes de autocarro.		0.368	0.664	
16) Sinto que os condutores de autocarro têm uma boa atitude perante mim.	0.467		0.5	0.421
4) É fácil para mim orientar-me nas estações de autocarro e quando faço ligações com outros transportes.				0.87

Extraction Method: PCA

Rotation Method: Varimax with Kaiser Normalization a Rotation converged in 5 iterations.

Item 9.64 - Principal Component Analysis with Varimax rotation, Bus Transportation (own authorship)

1

Reliability Statistics

Cronbach's Alpha	N of Items
0.707	3

2

Reliability Statistics

Cronbach's Alpha	N of Items
0.880	4

3

Reliability Statistics

Cronbach's Alpha	N of Items
0.766	5

4 Individual

Item 9.65 - Cronbach's Alpha Reliability Test (own authorship)

Metro performance test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.746
Bartlett's Test of Sphericity	Approx. Chi-Square	698.146
	df	91
	Sig.	0

Item 9.66 - KMO and Bartlett's Test, Metro Transportation (own authorship)

Communalities	Initial	Extraction
1) O tempo que espero pelo metro é aceitável.	1.000	0.650
2) Eu chego depressa ao meu destino quando ando de metro.	1.000	0.561
3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua pontualidade.	1.000	0.652
4) É fácil para mim orientar-me nas estações de metro e quando faço ligações com outros transportes.	1.000	0.520
8) Sinto-me segura/o quando me encaminho para a estação de metro.	1.000	0.712
9) Sinto-me seguro/a enquanto espero na estação de metro.	1.000	0.789
10) Sinto-me seguro/a dentro do metro durante uma viagem.	1.000	0.706
13) Sinto que o metro tem as medidas necessárias implementadas contra possíveis acidentes.	1.000	0.655
14) Em caso de emergência dentro do metro ou na estação, sei a polícia e os elementos responsáveis por garantir a segurança dos passageiros reagem de forma rápida e coordenada.	1.000	0.580
18) Eu considero que as carruagens do metro têm um aspeto novo e apelativo.	1.000	0.738
19) Considero que o ambiente das estações de metro é limpo e confortável.	1.000	0.646
22) É fácil para mim efetuar a compra de bilhetes de metro.	1.000	0.591
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do metro e relacionada com o funcionamento das linhas de metro.	1.000	0.577
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de metro de forma imediata e bem visível.	1.000	0.651

Extraction Method: PCA

Item 9.67 - Principal Component Analysis Communalities, Metro Transportation (own authorship)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	4.051	28.933	28.933	4.051	28.933	28.933	3.054	21.817	21.817
2	2.344	16.745	45.678	2.344	16.745	45.678	2.355	16.819	38.636
3	1.434	10.241	55.919	1.434	10.241	55.919	1.997	14.264	52.900
4	1.200	8.571	64.490	1.200	8.571	64.490	1.623	11.590	64.490
5	0.905	6.467	70.957						
6	0.793	5.666	76.623						
7	0.599	4.282	80.905						
8	0.574	4.102	85.007						
9	0.514	3.674	88.681						
10	0.449	3.210	91.891						
11	0.389	2.777	94.668						
12	0.308	2.198	96.866						
13	0.264	1.889	98.755						
14	0.174	1.245	100.000						

Extraction Method: PCA

Item 9.68 - Total Variance Explained, Metro Transportation (own authorship)

Rotated Component Matrix Importance	Component			
	1	2	3	4
9) Sinto-me seguro/a enquanto espero na estação de metro.	0.860			
10) Sinto-me seguro/a dentro do metro durante uma viagem.	0.803			
8) Sinto-me segura/o quando me encaminho para a estação de metro.	0.790			
4) É fácil para mim orientar-me nas estações de metro e quando faço ligações com outros transportes.	0.686			
22) É fácil para mim efetuar a compra de bilhetes de metro.	0.597	- 0.302		0.376
3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua pontualidade.		0.778		
2) Eu chego depressa ao meu destino quando ando de metro.		0.718		
1) O tempo que espero pelo metro é aceitável.		0.699		0.380
13) Sinto que o metro tem as medidas necessárias implementadas contra possíveis acidentes.			0.765	
14) Em caso de emergência dentro do metro ou na estação, sei a polícia e os elementos responsáveis por garantir a segurança dos passageiros reagem de forma rápida e coordenada.			0.663	0.371
18) Eu considero que as carruagens do metro têm um aspeto novo e apelativo.		0.485	0.619	- 0.321
19) Considero que o ambiente das estações de metro é limpo e confortável.	0.304	0.438	0.600	
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de metro de forma imediata e bem visível.				0.752

Extraction Method: PCA

Rotation Method: Varimax with Kaiser Normalization a Rotation converged in 5 iterations.

Item 9.69 - Principal Component Analysis with Varimax rotation, Metro Transportation (own authorship)

1

Reliability Statistics	
Cronbach's Alpha	N of Items
0.808	5

2

Reliability Statistics	
Cronbach's Alpha	N of Items
0.735	3

3

Reliability Statistics	
Cronbach's Alpha	N of Items
0.696	4

4

Reliability Statistics	
Cronbach's Alpha	N of Items
0.657	2

Item 9.70 - Cronbach's Alpha Reliability Test (own authorship)

Metro importance test		
KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.882
Bartlett's Test of Sphericity	Approx. Chi-Square	1432.737
	df	91
	Sig.	0

Item 9.71 - KMO and Bartlett's Test, Metro Transportation (own authorship)

Communalities	Initial	Extraction
1) O tempo que espero pelo metro é aceitável.	1.000	0.801
2) Eu chego depressa ao meu destino quando ando de metro.	1.000	0.765
3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua pontualidade.	1.000	0.777
4) É fácil para mim orientar-me nas estações de metro e quando faço ligações com outros transportes.	1.000	0.608
8) Sinto-me segura/o quando me encaminho para a estação de metro.	1.000	0.799
9) Sinto-me seguro/a enquanto espero na estação de metro.	1.000	0.874
10) Sinto-me seguro/a dentro do metro durante uma viagem.	1.000	0.829
13) Sinto que o metro tem as medidas necessárias implementadas contra possíveis acidentes.	1.000	0.708
14) Em caso de emergência dentro do metro ou na estação, sei a polícia e os elementos responsáveis por garantir a segurança dos passageiros reagem de forma rápida e coordenada.	1.000	0.725
18) Eu considero que as carruagens do metro têm um aspeto novo e apelativo.	1.000	0.634
19) Considero que o ambiente das estações de metro é limpo e confortável.	1.000	0.752
22) É fácil para mim efetuar a compra de bilhetes de metro.	1.000	0.752
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do metro e relacionada com o funcionamento das linhas de metro.	1.000	0.783
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de metro de forma imediata e bem visível.	1.000	0.797

Extraction Method: PCA

Item 9.72 - Principal Component Analysis Communalities, Metro Transportation (own authorship)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	7.422	53.013	53.013	7.422	53.013	53.013	3.132	22.371	22.371
2	1.244	8.888	61.901	1.244	8.888	61.901	2.979	21.276	43.647
3	1.055	7.536	69.437	1.055	7.536	69.437	2.619	18.710	62.358
4	0.882	6.302	75.740	0.882	6.302	75.740	1.874	13.382	75.740
5	0.836	5.974	81.714						
6	0.539	3.851	85.565						
7	0.518	3.698	89.263						
8	0.353	2.522	91.785						
9	0.265	1.889	93.675						
10	0.254	1.812	95.487						
11	0.204	1.460	96.946						
12	0.195	1.394	98.340						
13	0.170	1.213	99.554						
14	0.063	0.446	100.000						

Extraction Method: PCA

Item 9.73 - Total Variance Explained, Metro Transportation (own authorship)

Rotated Component Matrix Performance	Component			
	1	2	3	4
9) Sinto-me seguro/a enquanto espero na estação de metro.	0.782	0.428		
8) Sinto-me segura/o quando me encaminho para a estação de metro.	0.772	0.282	0.309	
10) Sinto-me seguro/a dentro do metro durante uma viagem.	0.733	0.446	0.281	
4) É fácil para mim orientar-me nas estações de metro e quando faço ligações com outros transportes.	0.722			
14) Em caso de emergência dentro do metro ou na estação, sei a polícia e os elementos responsáveis por garantir a segurança dos passageiros reagem de forma rápida e coordenada.	0.335	0.737		
18) Eu considero que as carruagens do metro têm um aspeto novo e apelativo.		0.727	0.251	
19) Considero que o ambiente das estações de metro é limpo e confortável.	0.325	0.710		0.297
13) Sinto que o metro tem as medidas necessárias implementadas contra possíveis acidentes.	0.415	0.708		
1) O tempo que espero pelo metro é aceitável.		0.289	0.829	
2) Eu chego depressa ao meu destino quando ando de metro.	0.358		0.771	
3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua pontualidade.	0.337		0.767	
27) Considero que as aplicações de navegação apresentam informação atualizada do tempo de chegada do metro e relacionada com o funcionamento das linhas de metro.		0.268	0.395	0.742
22) É fácil para mim efetuar a compra de bilhetes de metro.	0.441			0.734

Extraction Method: PCA

Rotation Method: Varimax with Kaiser Normalization a Rotation converged in 5 iterations.

Item 9.74 - Principal Component Analysis with Varimax rotation, Metro Transportation (own authorship)

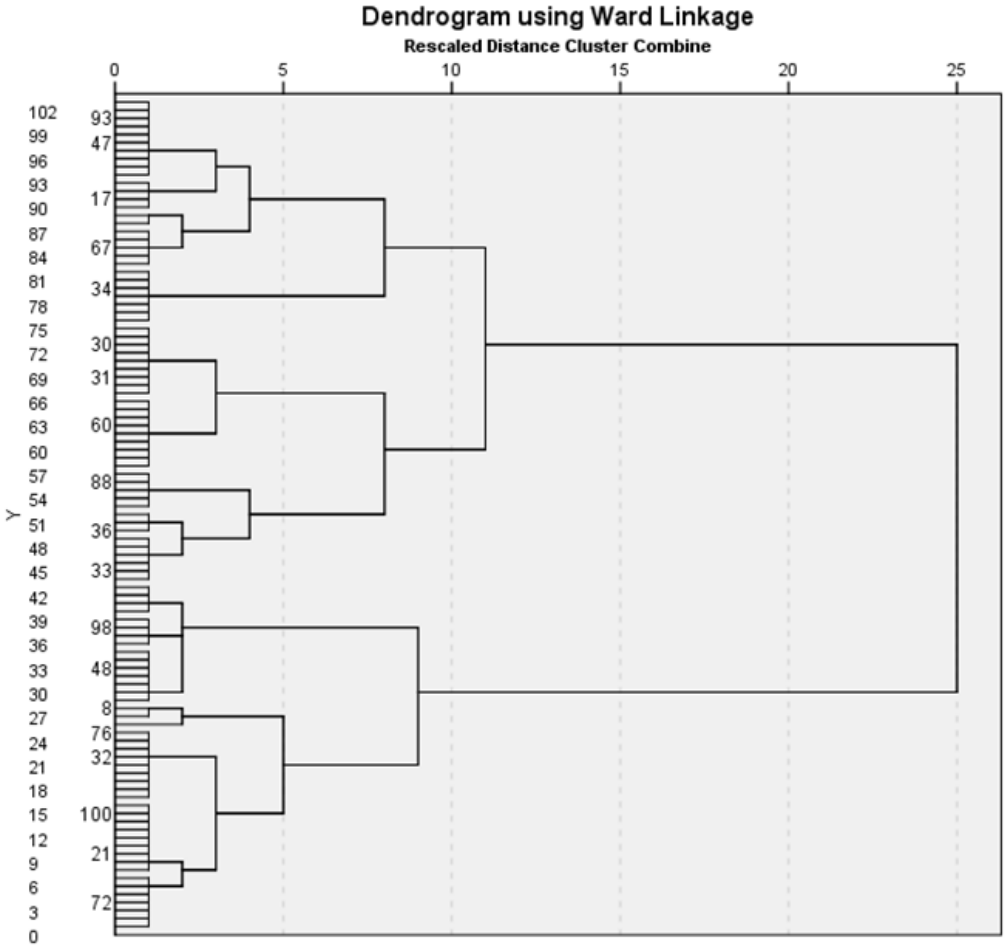
	Reliability Statistics	
1	Cronbach's Alpha	N of Items
	0.824	4
	Reliability Statistics	
2	Cronbach's Alpha	N of Items
	0.856	3
	Reliability Statistics	
3	Cronbach's Alpha	N of Items
	0.854	4
	Reliability Statistics	
4	Cronbach's Alpha	N of Items
	0.774	3

Item 9.75 - Cronbach's Alpha Reliability Test (own authorship)

ANNEX E – CLUSTER ANALYSIS – DENDOGRAM AND CHI-SQUARE TESTS FOR BUS AND METRO

ANOVA	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
1) O tempo que espero pelo autocarro é aceitável.	10.268	2	0.469	100	21.883	0.000
10) Sinto-me seguro/a dentro do autocarro durante uma viagem.	12.286	2	0.388	100	31.693	0.000
21) As pessoas que trabalham nas estações de autocarro estão sempre disponíveis para ajudar-me se precisar.	13.850	2	0.476	100	29.074	0.000
25) É fácil para mim recolher informação antes e durante o decorrer de uma viagem.	14.028	2	0.529	100	26.529	0.000
The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.	There is significance in this case, so the variants were useful in determining the different cluster memberships.					

Item 9.76 - ANOVA test, Bus Transportation (own authorship)



Item 9.77 - Hierarchical method, Dendrogram Bus transport (own authorship)

3 Clusters				4 Clusters			
Symmetric Measures				**Symmetric Measures**			
		Value	Approximate Significance			Value	Approximate Significance
Nominal by Nominal	Phi	0.326	0.280	Nominal by Nominal	Phi	0.243	0.108
	Cramer's V	0.188	0.280		Cramer's V	0.243	0.108
N of Valid Cases		103		N of Valid Cases		103	
Symmetric Measures				**Symmetric Measures**			
		Value	Approximate Significance			Value	Approximate Significance
Nominal by Nominal	Phi	0.202	0.898	Nominal by Nominal	Phi	0.225	0.950
	Cramer's V	0.117	0.898		Cramer's V	0.130	0.950
N of Valid Cases		103		N of Valid Cases		103	
Symmetric Measures				**Symmetric Measures**			
		Value	Approximate Significance			Value	Approximate Significance

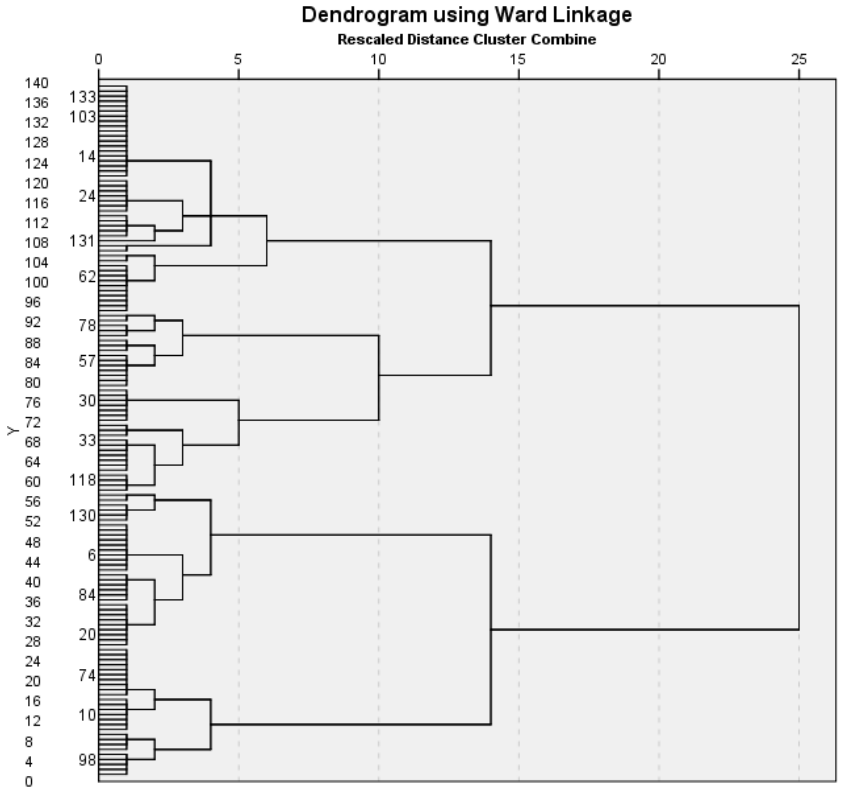
Nominal by Nominal	Phi	0.263	0.625	Nominal by Nominal	Phi	0.255	0.352
	Cramer's V	0.152	0.625		Cramer's V	0.180	0.352
N of Valid Cases		103		N of Valid Cases		103	
Symmetric Measures				**Symmetric Measures**			
		Value	Approximate Significance			Value	Approximate Significance
Nominal by Nominal	Phi	0.490	0.016	Nominal by Nominal	Phi	0.368	0.003
	Cramer's V	0.283	0.016		Cramer's V	0.368	0.003
N of Valid Cases		103		N of Valid Cases		103	
Symmetric Measures				**Symmetric Measures**			
		Value	Approximate Significance			Value	Approximate Significance
Nominal by Nominal	Phi	0.409	0.046	Nominal by Nominal	Phi	0.283	0.221
	Cramer's V	0.236	0.046		Cramer's V	0.200	0.221
N of Valid Cases		103		N of Valid Cases		103	
Symmetric Measures				**Symmetric Measures**			
		Value	Approximate Significance			Value	Approximate Significance
Nominal by Nominal	Phi	0.071	0.914	Nominal by Nominal	Phi	0.719	0.000
	Cramer's V	0.071	0.914		Cramer's V	0.415	0.000
N of Valid Cases		103		N of Valid Cases		103	
Symmetric Measures							
		Value	Approximate Significance				
Nominal by Nominal	Phi	0.084	0.867				
	Cramer's V	0.084	0.867				
N of Valid Cases		103					

Item 9.78 - Phi-Squared Values per cluster division, Bus Transportation (own authorship)

ANOVA

	Cluster Mean Square	df	Error Mean Square	df	F	Sig.
3) Considero que o serviço do metro respeita o horário estabelecido e aprecio a sua pontualidade.	17.856	3	0.436	135	40.972	0.000
9) Sinto-me seguro/a enquanto espero na estação de metro.	13.210	3	0.325	135	40.706	0.000
13) Sinto que o metro tem as medidas necessárias implementadas contra possíveis acidentes.	9.440	3	0.470	135	20.095	0.000
28) Quando existe um problema técnico ou operacional, a informação é-me transmitida nas estações de metro de forma imediata e bem visível.	15.905	3	0.372	135	42.796	0.000
The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.	There is significance in this case, so the variants were useful in determining the different cluster.					

Item 9.79 - ANOVA test, Metro Transportation (own authorship)



Item 9.80 - Hierarchical method, DendrogramMetro transport (own authorship)

4 Clusters					5 Clusters			
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.309	0.150		Nominal by Nominal	Phi	0.309	0.150
	Cramer's V	0.179	0.150			Cramer's V	0.179	0.150
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.353	0.044		Nominal by Nominal	Phi	0.353	0.044
	Cramer's V	0.204	0.044			Cramer's V	0.204	0.044
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.350	0.048		Nominal by Nominal	Phi	0.350	0.048
	Cramer's V	0.202	0.048			Cramer's V	0.202	0.048
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.148	0.387		Nominal by Nominal	Phi	0.148	0.387
	Cramer's V	0.148	0.387			Cramer's V	0.148	0.387
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.304	0.381		Nominal by Nominal	Phi	0.304	0.381
	Cramer's V	0.175	0.381			Cramer's V	0.175	0.381
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.159	0.742		Nominal by Nominal	Phi	0.159	0.742
	Cramer's V	0.112	0.742			Cramer's V	0.112	0.742
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.213	0.900		Nominal by Nominal	Phi	0.213	0.900
	Cramer's V	0.123	0.900			Cramer's V	0.123	0.900
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.171	0.907		Nominal by Nominal	Phi	0.171	0.907
	Cramer's V	0.099	0.907			Cramer's V	0.099	0.907
N of Valid Cases		139			N of Valid Cases		139	

Symmetric Measures					Symmetric Measures			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.129	0.512		Nominal by Nominal	Phi	0.129	0.512
	Cramer's V	0.129	0.512			Cramer's V	0.129	0.512
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.143	0.418		Nominal by Nominal	Phi	0.143	0.418
	Cramer's V	0.143	0.418			Cramer's V	0.143	0.418
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.170	0.677		Nominal by Nominal	Phi	0.170	0.677
	Cramer's V	0.120	0.677			Cramer's V	0.120	0.677
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.438	0.085		Nominal by Nominal	Phi	0.438	0.085
	Cramer's V	0.253	0.085			Cramer's V	0.253	0.085
N of Valid Cases		139			N of Valid Cases		139	
Symmetric Measures					**Symmetric Measures**			
		Value	Approximate Significance				Value	Approximate Significance
Nominal by Nominal	Phi	0.204	0.123		Nominal by Nominal	Phi	0.204	0.123
	Cramer's V	0.204	0.123			Cramer's V	0.204	0.123
N of Valid Cases		139			N of Valid Cases		139	

Item 9.81 - Phi-Squared Values per cluster division, Metro Transportation (own authorship)

ANNEX F – SOCIAL AND DEMOGRAPHIC CLUSTER CHARACTERIZATION

Por favor indique em que cidade, ou perto de que cidade reside.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Fora de Portugal	1	2	1	4	1.92	8.70	3.57	3.88
Lisboa	42	13	24	79	80.77	56.52	85.71	76.70
Outra cidade em Portugal	7	7	2	16	13.46	30.43	7.14	15.53
Porto	2	1	1	4	3.85	4.35	3.57	3.88
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.82 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Com que frequência utiliza este meio de transporte?								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
1 a 2 vezes por semana	12	3	4	19	23.08	13.04	14.29	18.45
Entre 3 a 4 vezes por semana	11	7	9	27	21.15	30.43	32.14	26.21
Mais de 5 vezes por semana	25	11	10	46	48.08	47.83	35.71	44.66
Raramente	4	2	5	11	7.69	8.70	17.86	10.68
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.83 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

	Qual é o principal propósito da utilização do transporte?							
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Compras ou outras necessidades	6	1	2	9	11.54	4.35	7.14	8.74
Educação	11	6	5	22	21.15	26.09	17.86	21.36
Lazer	5	6	8	19	9.62	26.09	28.57	18.45
Trabalho	30	10	13	53	57.69	43.48	46.43	51.46
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.84 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Por favor indique o seu género.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Feminino	33	12	16	61	63.46	52.17	57.14	59.22
Masculino	19	11	12	42	36.54	47.83	42.86	40.78
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.85 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Indique a sua idade.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Entre 18 e 24 anos	17	12	13	42	32.69	52.17	46.43	40.78
Entre 25 e 34 anos	11	3	2	16	21.15	13.04	7.14	15.53
Entre 35 e 49 anos	8	4	4	16	15.38	17.39	14.29	15.53
Entre 50 e 66 anos	15	4	8	27	28.85	17.39	28.57	26.21
Mais de 67 anos	1	0	1	2	1.92	0.00	3.57	1.94
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.86 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Indique o seu grau académico.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Ensino secundário	7	6	6	19	13.46	26.09	21.43	18.45
Licenciado/a	32	12	15	59	61.54	52.17	53.57	57.28
Mestre ou acima	13	5	7	25	25.00	21.74	25.00	24.27
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.87 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Por favor indique a ocupação que melhor o/a descreve.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Aposentado/a	1	0	2	3	1.92	0.00	7.14	2.91
Dono/a de casa	1	0	0	1	1.92	0.00	0.00	0.97
Estudante	8	6	6	20	15.38	26.09	21.43	19.42
Trabalhador/a	38	15	18	71	73.08	65.22	64.29	68.93
Trabalho por conta própria	4	2	2	8	7.69	8.70	7.14	7.77
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.88 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Indique o seu rendimento mensal líquido.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Menos de 800 €	9	8	5	22	17.31	34.78	17.86	21.36
Entre 800 € e 1200 €	16	5	13	34	30.77	21.74	46.43	33.01
Entre 1200 € e 1700 €	20	8	9	37	38.46	34.78	32.14	35.92
Mais de 1700 €	7	2	1	10	13.46	8.70	3.57	9.71
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.89 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

É portador de carta de condução?								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Não	10	4	6	20	19.23	17.39	21.43	19.42
Sim	42	19	22	83	80.77	82.61	78.57	80.58
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.90 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Possui pelo menos um veículo pessoal?								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Não	21	12	9	42	40.38	52.17	32.14	40.78
Sim	31	11	19	61	59.62	47.83	67.86	59.22
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.91 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Indique o tipo de localidade onde vive.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Centro rural	2	1	0	3	3.85	4.35	0.00	2.91
Centro urbano	34	14	19	67	65.38	60.87	67.86	65.05
Periferia de centro urbano	16	8	9	33	30.77	34.78	32.14	32.04
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.92 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Indique o método de pagamento que geralmente mais usa para comprar bilhetes de Transporte Público.								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Atm	1	0	0	1	1.92	0.00	0.00	0.97
Balcão de serviço ao cliente	3	2	5	10	5.77	8.70	17.86	9.71
Bilheteiras automáticas	35	16	17	68	67.31	69.57	60.71	66.02
Diretamente ao condutor (quando aplicável)	2	0	1	3	3.85	0.00	3.57	2.91
Multibanco	2	1	0	3	3.85	4.35	0.00	2.91
Multibanco (passe)	1	0	0	1	1.92	0.00	0.00	0.97
Online	7	4	4	15	13.46	17.39	14.29	14.56
Passe	1	0	1	2	1.92	0.00	3.57	1.94
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.93 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Utiliza o passe mensal para Transportes Públicos?								
	Cluster Number			Total	Percentage			Total
	1	2	3		1	2	3	
Não	22	12	11	45	42.31	52.17	39.29	43.69
Sim	30	11	17	58	57.69	47.83	60.71	56.31
	52	23	28	103	50.49	22.33	27.18	100.00

Item 9.94 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

	Por favor indique em que cidade, ou perto de que cidade reside.									
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Fora de Portugal	0	1	1	2	4	0.00	1.96	4.35	4.88	2.88
Lisboa	20	26	17	27	90	83.33	50.98	73.91	65.85	64.75
Outra cidade em Portugal	4	22	4	12	42	16.67	43.14	17.39	29.27	30.22
Porto	0	2	1	0	3	0.00	3.92	4.35	0.00	2.16
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.95 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

	Com que frequência utiliza este meio de transporte?									
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Raramente	5	23	6	20	54	20.83	45.10	26.09	48.78	38.85
Entre 1 a 2 vezes por semana	1	10	4	6	21	4.17	19.61	17.39	14.63	15.11
Entre 3 a 4 vezes por semana	4	6	5	3	18	16.67	11.76	21.74	7.32	12.95
Mais de 5 vezes por semana	14	12	8	12	46	58.33	23.53	34.78	29.27	33.09
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.96 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Qual é o principal propósito da utilização do transporte?										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Compras ou outras necessidades	2	7	2	4	15	8.33	13.73	8.70	9.76	10.79
Educação	1	6	0	10	17	4.17	11.76	0.00	24.39	12.23
Lazer	5	18	6	15	44	20.83	35.29	26.09	36.59	31.65
Trabalho	16	20	15	12	63	66.67	39.22	65.22	29.27	45.32
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.97 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Por favor indique o seu género.										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Feminino	17	35	14	23	89	70.83	68.63	60.87	56.10	64.03
Masculino	7	16	9	18	50	29.17	31.37	39.13	43.90	35.97
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.98 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Indique a sua idade.										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Entre 18 e 24 anos	5	13	8	13	39	20.83	25.49	34.78	31.71	28.06
Entre 25 e 34 anos	10	10	7	8	35	41.67	19.61	30.43	19.51	25.18
Entre 35 e 49 anos	6	8	3	5	22	25.00	15.69	13.04	12.20	15.83
Entre 50 e 66 anos	3	19	4	14	40	12.50	37.25	17.39	34.15	28.78
Mais de 67 anos	0	1	1	1	3	0.00	1.96	4.35	2.44	2.16
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.99 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Indique o seu grau académico.										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Ensino secundário	1	6	3	4	14	4.17	11.76	13.04	9.76	10.07
Licenciado/a	9	25	10	22	66	37.50	49.02	43.48	53.66	47.48
Mestre ou acima	14	20	10	15	59	58.33	39.22	43.48	36.59	42.45
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.100 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Por favor indique a ocupação que melhor o/a descreve.										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Aposentado/a	0	1	1	1	3	0.00	1.96	4.35	2.44	2.16
Desempregado/a	0	1	0	0	1	0.00	1.96	0.00	0.00	0.72
Estudante	2	4	1	6	13	8.33	7.84	4.35	14.63	9.35
Trabalhador/a	19	39	21	32	111	79.17	76.47	91.30	78.05	79.86
Trabalho por conta própria	3	6	0	2	11	12.50	11.76	0.00	4.88	7.91
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.101 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Indique o seu rendimento mensal líquido.										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Menos de 800 €	2	5	1	4	12	8.33	9.80	4.35	9.76	8.63
Entre 800 € e 1200 €	9	13	8	13	43	37.50	25.49	34.78	31.71	30.94
Entre 1201 e 1700 €	9	22	9	14	54	37.50	43.14	39.13	34.15	38.85
Mais de 1700€	4	11	5	10	30	16.67	21.57	21.74	24.39	21.58
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.102 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

É portador de carta de condução?										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Não	1	8	2	2	13	4.17	15.69	8.70	4.88	9.35
Sim	23	43	21	39	126	95.83	84.31	91.30	95.12	90.65
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.103 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Possui pelo menos um veículo pessoal?										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Não	8	16	7	7	38	33.33	31.37	30.43	17.07	27.34
Sim	16	35	16	34	101	66.67	68.63	69.57	82.93	72.66
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.104 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Indique o tipo de localidade onde vive.										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Centro rural	0	4	2	1	7	0.00	7.84	8.70	2.44	5.04
Centro urbano	17	28	13	25	83	70.83	54.90	56.52	60.98	59.71
Periferia de centro urbano	7	19	8	15	49	29.17	37.25	34.78	36.59	35.25
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.105 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

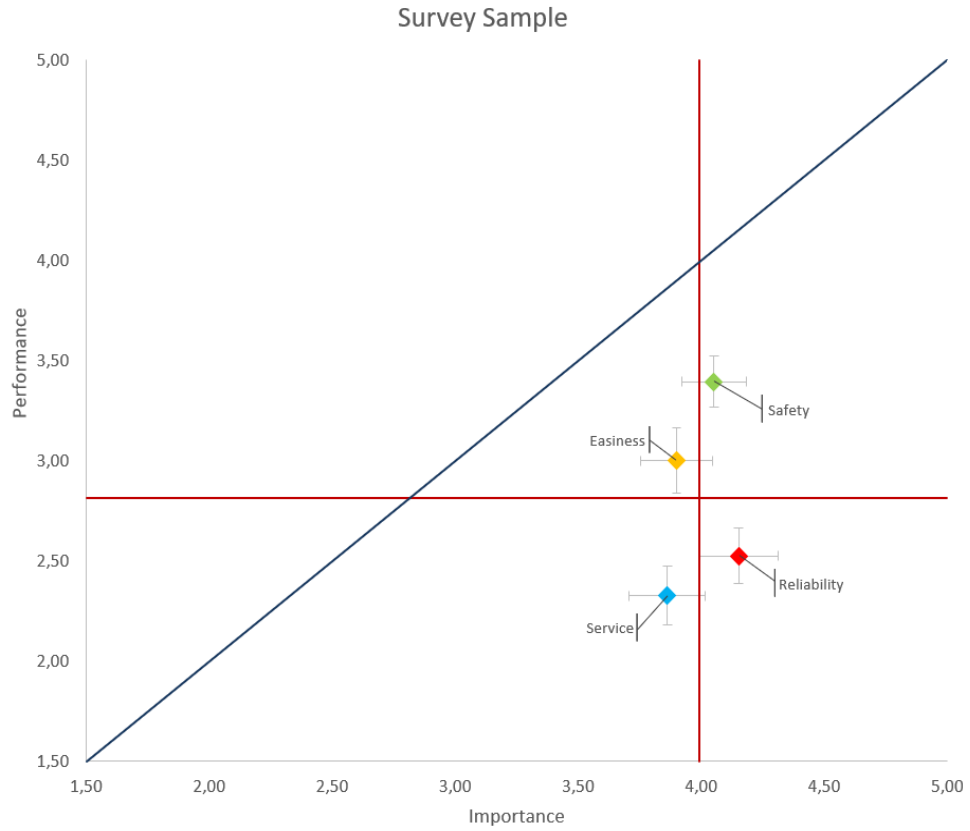
Indique o método de pagamento que geralmente mais usa para comprar bilhetes de Transporte Público.										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Balcão de serviço ao cliente	0	4	3	3	10	0.00	7.84	13.04	7.32	7.19
Bilheteiras automáticas	17	31	16	27	91	70.83	60.78	69.57	65.85	65.47
Diretamente ao condutor (quando aplicável)	0	2	0	0	2	0.00	3.92	0.00	0.00	1.44
MB	0	1	0	0	1	0.00	1.96	0.00	0.00	0.72
Multibanco	2	1	1	1	5	8.33	1.96	4.35	2.44	3.60
Online	4	12	3	10	29	16.67	23.53	13.04	24.39	20.86
Passe	1	0	0	0	1	4.17	0.00	0.00	0.00	0.72
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.106 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

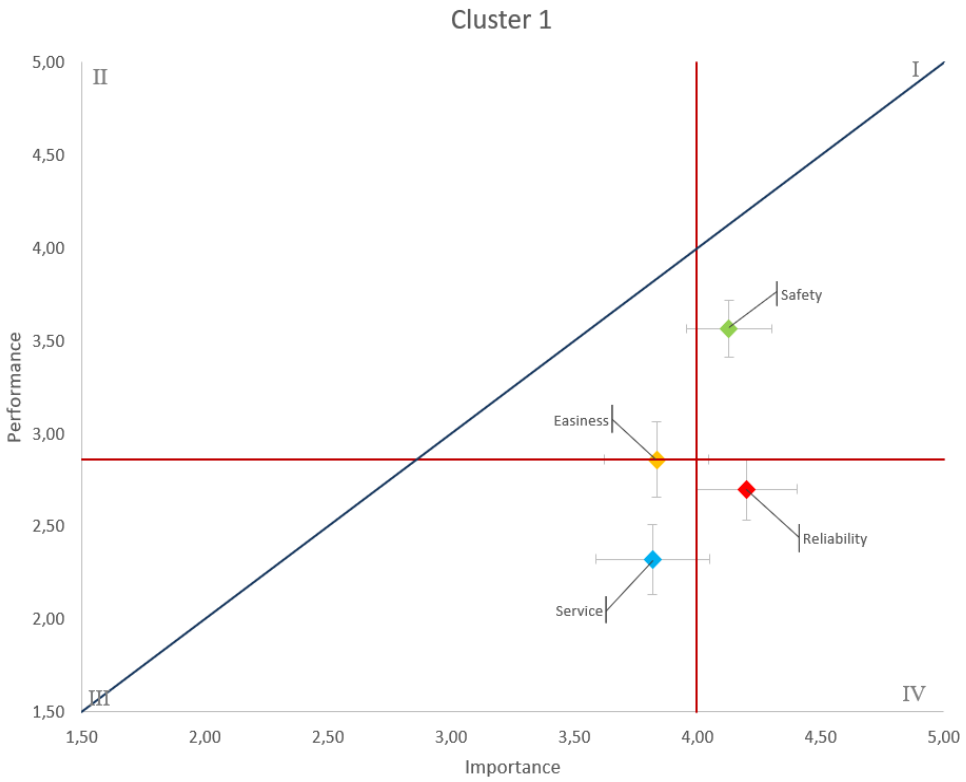
Utiliza o passe mensal para Transportes Públicos?										
	Cluster Number				Total	Percentage				Total
	1	2	3	4		1	2	3	4	
Não	7	28	10	24	69	29.17	54.90	43.48	58.54	49.64
Sim	17	23	13	17	70	70.83	45.10	56.52	41.46	50.36
	24	51	23	41	139	17.27	36.69	16.55	29.50	100.00

Item 9.107 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

ANNEX G – IMPORTANCE-PERFORMANCE ANALYSIS RESULTS



Item 9.108 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)



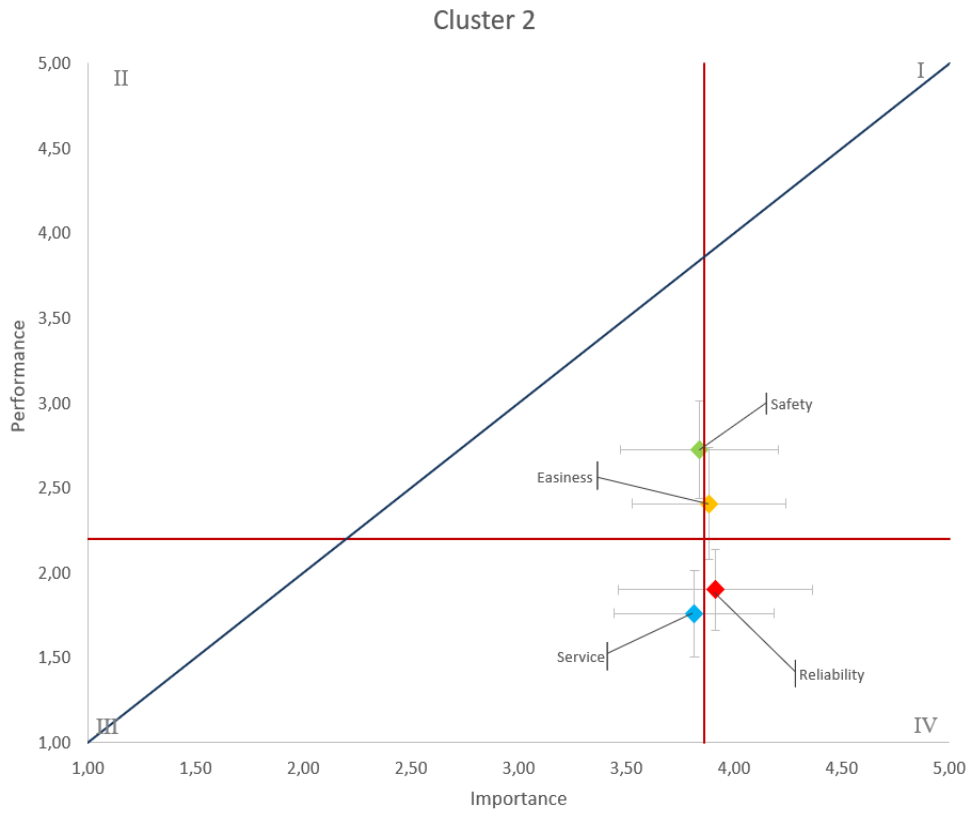
Item 9.109 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Attributes	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
Time waiting	2.87	2.73	3.00	4.31	4.11	4.51	-1.44
Travel time	2.85	2.66	3.03	4.10	3.90	4.29	-1.25
Punctuality	2.38	2.21	2.56	4.19	3.97	4.42	-1.81
Orientation	3.23	3.00	3.46	3.92	3.76	4.08	-0.69
Safety Waiting	3.44	3.28	3.61	4.13	3.95	4.32	-0.69
Safety in PT	3.83	3.69	3.97	4.40	4.23	4.57	-0.58
Drivers Attitude	3.42	3.27	3.58	3.85	3.68	4.01	-0.42
CS on site	2.46	2.30	2.62	3.56	3.35	3.76	-1.10
Seamless Ticketing	2.87	2.65	3.08	3.81	3.58	4.04	-0.94
Planning Capacity	2.48	2.31	2.65	3.77	3.53	4.01	-1.29
Information in PT	2.44	2.28	2.61	3.67	3.44	3.90	-1.23
App accuracy	2.38	2.16	2.61	4.04	3.79	4.29	-1.65
Information at stations	2.00	1.79	2.21	4.00	3.76	4.24	-2.00

Item 9.110 - Results of Bus Performance and Importance, Cluster 1 (own authorship)

Components	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
	2.70	2.53	2.86	4.20	3.99	4.40	-1.50
	2.86	2.65	3.06	3.83	3.62	4.04	-0.97
	3.56	3.41	3.72	4.13	3.95	4.30	-0.56
	2.32	2.13	2.51	3.82	3.59	4.05	-1.50

Item 9.111 - Components of Bus Performance and Importance, Cluster 1 (own authorship)



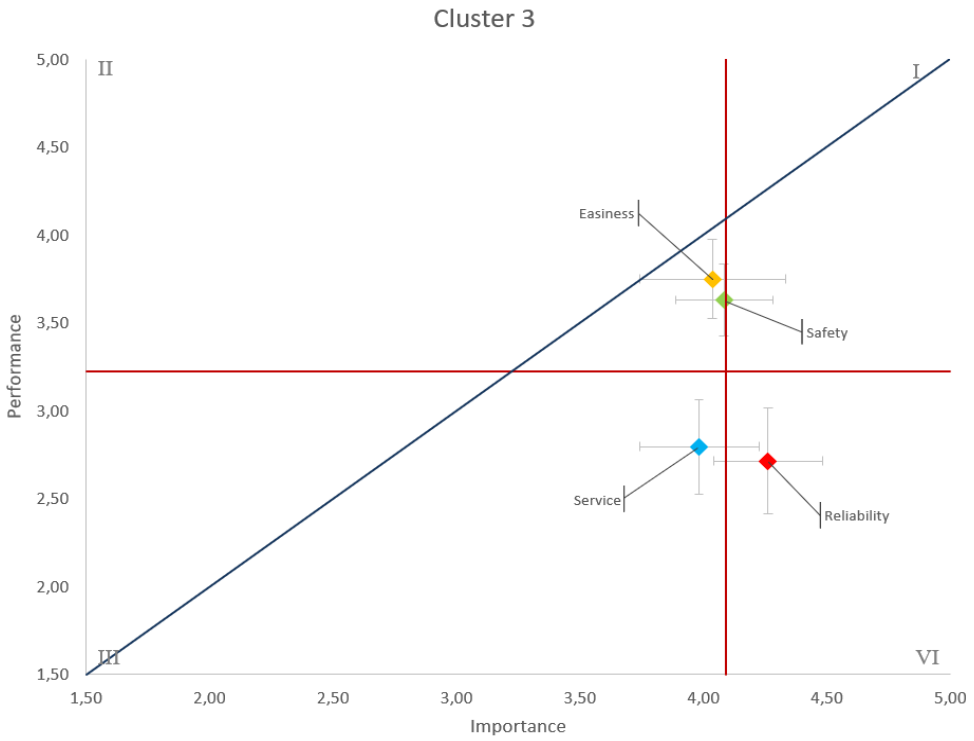
Item 9.112 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Attributes	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
Time waiting	1.74	1.53	1.95	3.96	3.49	4.42	-2.22
Travel time	2.35	2.13	2.57	3.83	3.44	4.21	-1.48
Punctuality	1.61	1.32	1.90	3.96	3.46	4.46	-2.35
Orientation	2.39	2.05	2.73	3.61	3.27	3.95	-1.22
Safety Waiting	2.65	2.32	2.99	4.00	3.61	4.39	-1.35
Safety in PT	2.65	2.41	2.90	3.87	3.49	4.25	-1.22
Drivers Attitude	2.87	2.59	3.15	3.65	3.32	3.99	-0.78
CS on site	1.87	1.59	2.15	3.78	3.47	4.09	-1.91
Seamless Ticketing	2.48	2.09	2.86	4.17	3.87	4.48	-1.70
Planning Capacity	2.35	2.08	2.61	3.87	3.44	4.30	-1.52
Information in PT	1.96	1.74	2.18	3.57	3.26	3.87	-1.61
App accuracy	1.87	1.57	2.17	3.96	3.56	4.35	-2.09
Information at stations	1.35	1.13	1.57	3.96	3.48	4.44	-2.61

Item 9.113 - Results of Bus Performance and Importance, Cluster 2 (own authorship)

Components	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
	1.90	1.66	2.14	3.91	3.46	4.36	-2.01
	2.41	2.08	2.74	3.88	3.53	4.24	-1.48
	2.72	2.44	3.01	3.84	3.47	4.21	-1.12
	1.76	1.51	2.02	3.82	3.44	4.19	-2.05

Item 9.114 - Components of Bus Performance and Importance, Cluster 2 (own authorship)



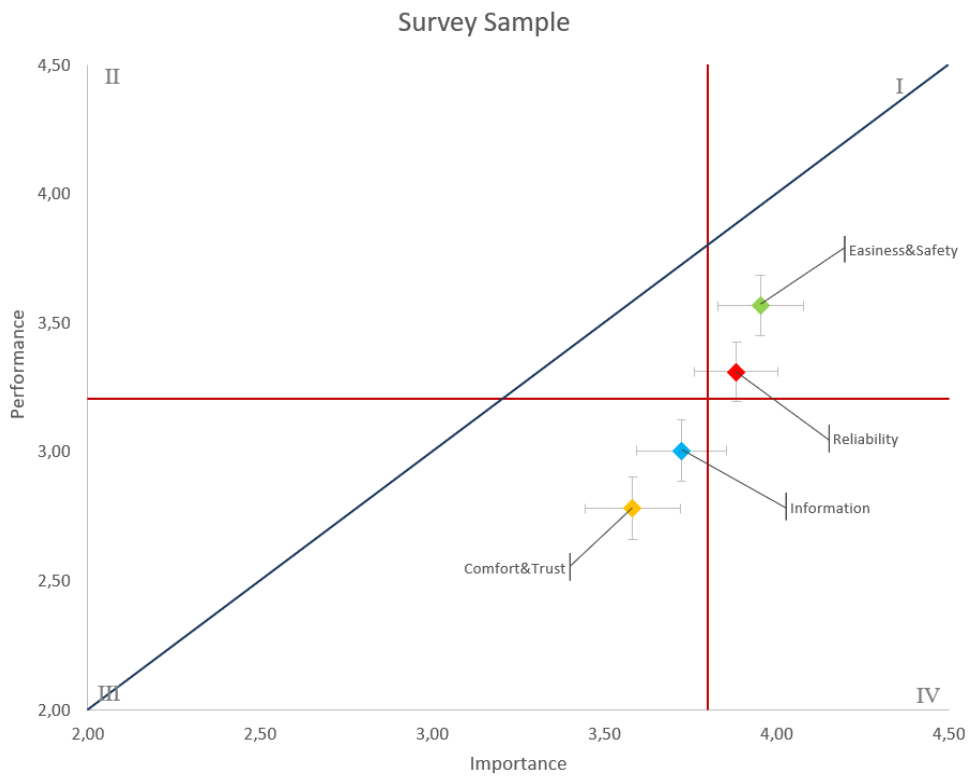
Item 9.115 - Social demographic characterisation of participants per cluster, Bus Transportation (own authorship)

Attributes	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
Time waiting	2.64	2.37	2.91	4.21	3.96	4.47	-1.57
Travel time	2.89	2.60	3.19	4.18	3.95	4.41	-1.29
Punctuality	2.61	2.28	2.94	4.39	4.22	4.56	-1.79
Orientation	3.82	3.57	4.08	4.07	3.86	4.29	-0.25
Safety Waiting	3.54	3.30	3.77	4.14	3.97	4.31	-0.61
Safety in PT	3.82	3.65	3.99	4.21	3.99	4.44	-0.39
Drivers Attitude	3.54	3.32	3.75	3.89	3.70	4.09	-0.36
CS on site	3.32	3.15	3.49	3.86	3.62	4.10	-0.54
Seamless Ticketing	3.82	3.60	4.05	4.04	3.68	4.39	-0.21
Planning Capacity	3.61	3.41	3.80	4.00	3.69	4.31	-0.39
Information in PT	3.00	2.76	3.24	3.71	3.47	3.96	-0.71
App accuracy	2.71	2.36	3.07	4.32	4.07	4.58	-1.61
Information at stations	2.14	1.83	2.46	4.04	3.81	4.26	-1.89

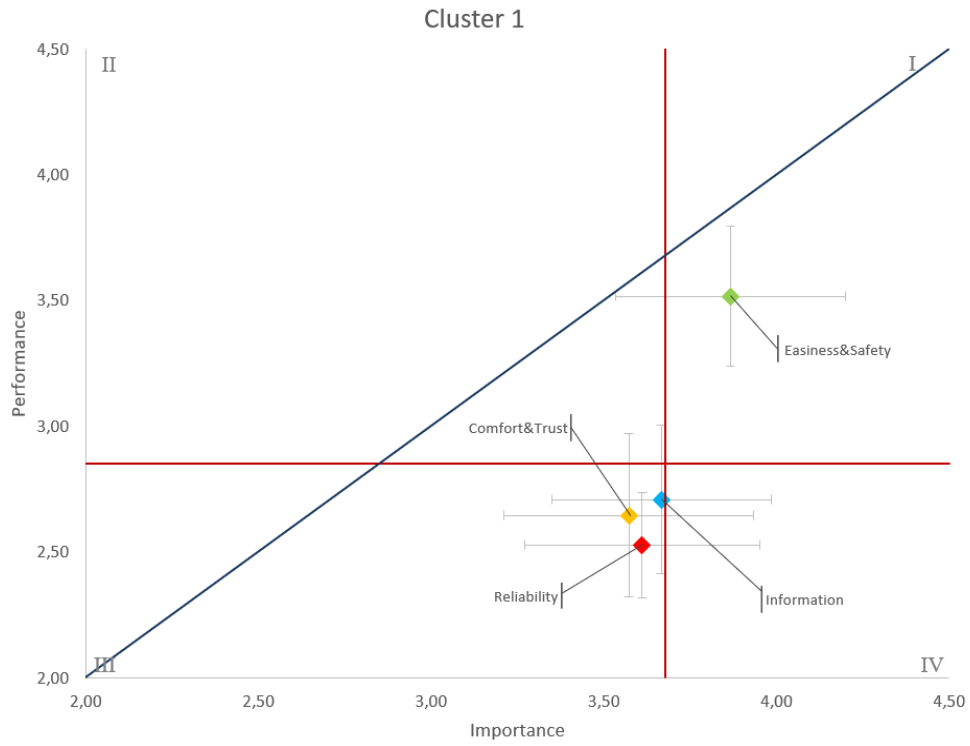
Item 9.116 - Results of Bus Performance and Importance, Cluster 3 (own authorship)

Components	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
	2.71	2.41	3.01	4.26	4.04	4.48	-1.55
	3.75	3.53	3.97	4.04	3.74	4.33	-0.29
	3.63	3.43	3.84	4.08	3.89	4.28	-0.45
	2.79	2.52	3.06	3.98	3.74	4.22	-1.19

Item 9.117 - Components of Bus Performance and Importance, Cluster 3 (own authorship)



Item 9.118 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)



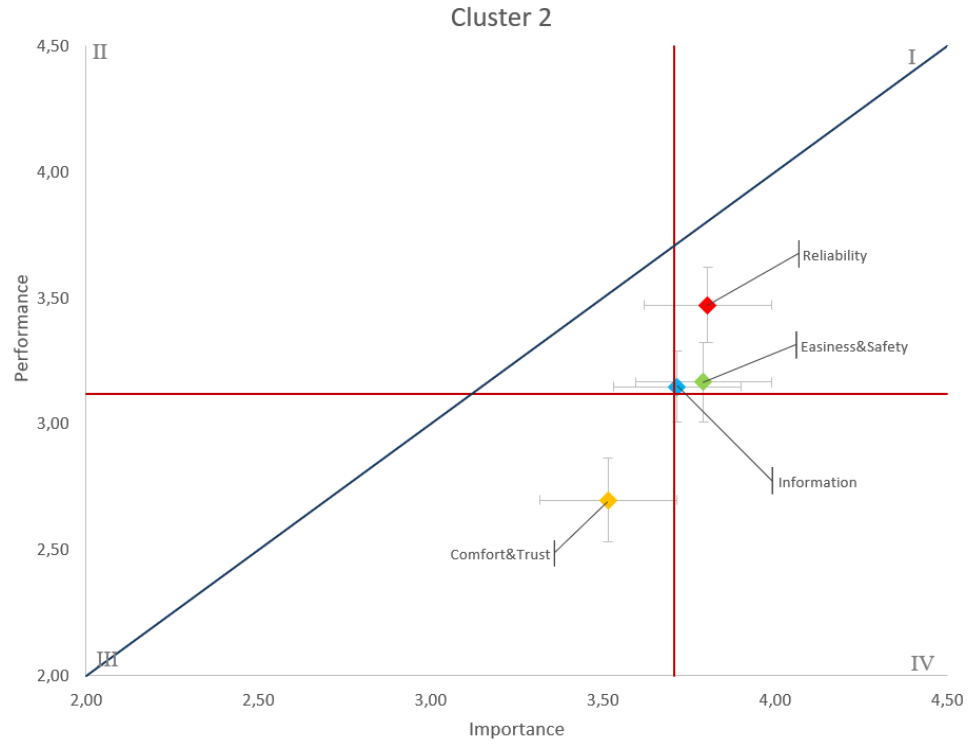
Item 9.119 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Attributes	Performance			Importance			Gap
	Average	CI 90%		Average	CI 90%		
Time waiting	2.50	2.30	2.70	3.75	3.47	4.03	-1.25
Travel time	3.21	2.93	3.49	3.71	3.40	4.01	-0.50
Punctuality	1.88	1.72	2.03	3.38	2.95	3.80	-1.50
Orientation	3.71	3.27	4.15	3.79	3.41	4.17	-0.08
Safety Surroundings	3.17	2.88	3.46	3.63	3.21	4.04	-0.46
Safety Waiting	3.42	3.22	3.61	3.92	3.60	4.23	-0.50
Safety in Transport	3.38	3.18	3.57	3.96	3.65	4.26	-0.58
Security Measures	3.08	2.79	3.38	4.13	3.82	4.43	-1.04
Emergency Reaction	2.67	2.36	2.97	3.83	3.47	4.20	-1.17
Transport appearance	2.46	2.12	2.80	2.92	2.51	3.32	-0.46
Cleanse and Comfort	2.38	2.02	2.73	3.42	3.05	3.79	-1.04
Seamless Ticketing	3.92	3.64	4.20	4.04	3.79	4.29	-0.13
App Accuracy	2.50	2.20	2.80	3.50	3.16	3.84	-1.00
Information at stations	2.92	2.62	3.21	3.83	3.54	4.12	-0.92

Item 9.120 - Results of Metro Performance and Importance, Cluster 1 (own authorship)

Components	Performance			Importance			Gap
	Average	CI 90%		Average	CI 90%		
	2.53	2.32	2.74	3.61	3.27	3.95	-1.08
	3.52	3.24	3.80	3.87	3.53	4.20	-0.35
	2.65	2.32	2.97	3.57	3.21	3.93	-0.93
	2.71	2.41	3.00	3.67	3.35	3.98	-0.96

Item 9.121 - Components of Metro Performance and Importance, Cluster 1 (own authorship)



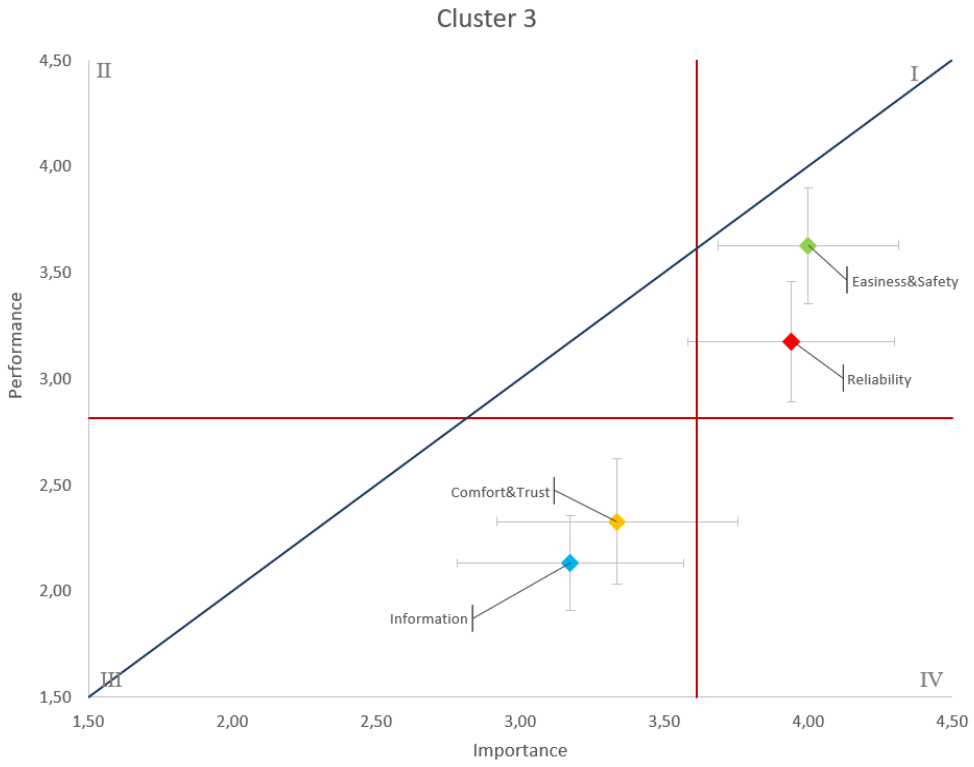
Item 9.122 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Attributes	Performance			Importance			Gap
	Average	CI 90%		Average	CI 90%		
Time waiting	3.43	3.27	3.59	3.71	3.52	3.89	-0.27
Travel time	3.53	3.37	3.68	3.84	3.66	4.02	-0.31
Punctuality	3.45	3.32	3.58	3.86	3.67	4.05	-0.41
Orientation	3.55	3.36	3.74	3.86	3.68	4.05	-0.31
Safety Surroundings	2.90	2.76	3.04	3.69	3.47	3.90	-0.78
Safety Waiting	2.78	2.67	2.90	3.73	3.52	3.93	-0.94
Safety in Transport	3.08	2.94	3.22	3.84	3.65	4.04	-0.76
Security Measures	2.80	2.67	2.93	3.71	3.51	3.90	-0.90
Emergency Reaction	2.75	2.60	2.89	3.67	3.46	3.87	-0.92
Transport appearance	2.49	2.29	2.69	3.22	3.03	3.40	-0.73
Cleanse and Comfort	2.75	2.56	2.93	3.47	3.26	3.68	-0.73
Seamless Ticketing	3.51	3.29	3.73	3.84	3.65	4.04	-0.33
App Accuracy	3.20	3.03	3.36	3.65	3.46	3.84	-0.45
Information at stations	3.10	2.98	3.21	3.78	3.60	3.96	-0.69

Item 9.123 - Results of Metro Performance and Importance, Cluster 2 (own authorship)

Components	Performance			Importance			Gap
	Average	CI 90%		Average	CI 90%		
	3.47	3.32	3.62	3.80	3.62	3.99	-0.33
	3.16	3.01	3.32	3.79	3.59	3.99	-0.63
	2.70	2.53	2.86	3.51	3.32	3.71	-0.82
	3.15	3.01	3.29	3.72	3.53	3.90	-0.57

Item 9.124 - Components of Metro Performance and Importance, cluster 2 (own authorship)



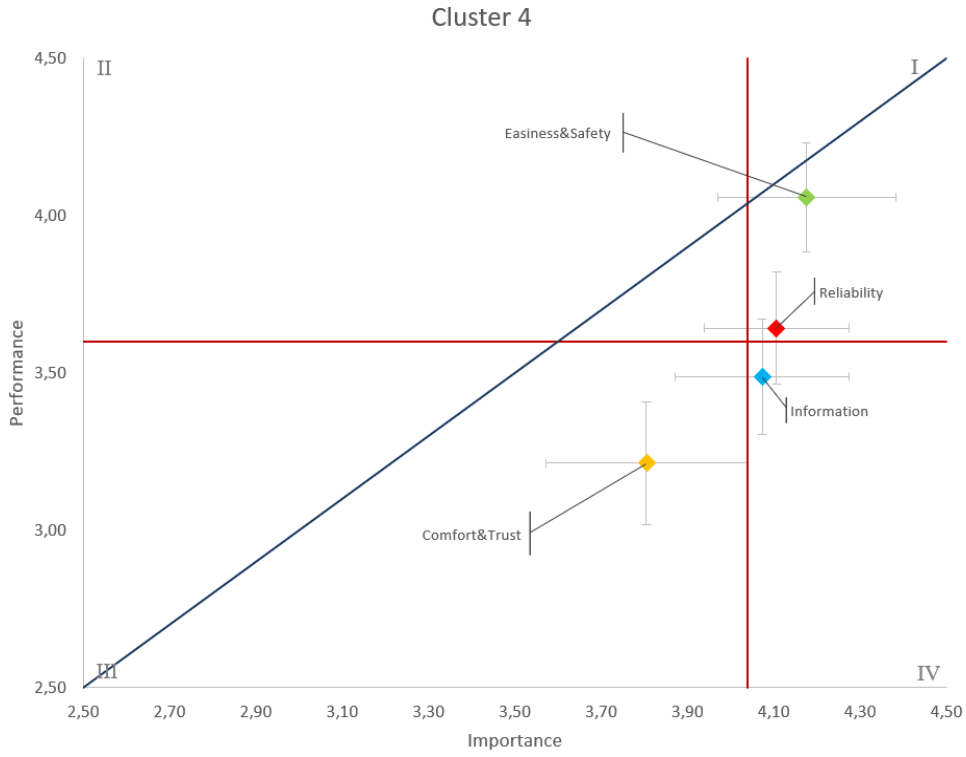
Item 9.125 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

Attributes	Performance			Importance			Gap
	Average	CI 90%		Average	CI 90%		
Time waiting	3.09	2.76	3.41	3.96	3.58	4.34	-0.87
Travel time	3.52	3.32	3.73	4.17	3.87	4.48	-0.65
Punctuality	2.91	2.59	3.24	3.70	3.30	4.09	-0.78
Orientation	3.96	3.67	4.24	3.83	3.49	4.16	0.13
Safety Surroundings	3.39	3.07	3.71	4.09	3.76	4.41	-0.70
Safety Waiting	3.52	3.29	3.75	4.13	3.83	4.43	-0.61
Safety in Transport	3.52	3.25	3.79	4.17	3.91	4.44	-0.65
Security Measures	2.17	1.89	2.46	3.52	3.03	4.02	-1.35
Emergency Reaction	2.17	1.91	2.44	3.57	3.13	4.00	-1.39
Transport appearance	2.35	2.01	2.68	2.91	2.54	3.28	-0.57
Cleanse and Comfort	2.61	2.32	2.90	3.35	2.98	3.72	-0.74
Seamless Ticketing	3.74	3.48	4.00	3.78	3.44	4.12	-0.04
App Accuracy	2.39	2.10	2.68	3.17	2.82	3.53	-0.78
Information at stations	1.87	1.71	2.03	3.17	2.74	3.61	-1.30

Item 9.126 - Results of Metro Performance and Importance, Cluster 3 (own authorship)

Components	Performance			Importance			Gap
	Average	CI 90%		Average	CI 90%		
	3.17	2.89	3.46	3.94	3.58	4.30	-0.77
	3.63	3.35	3.90	4.00	3.69	4.31	-0.37
	2.33	2.03	2.62	3.34	2.92	3.75	-1.01
	2.13	1.91	2.35	3.17	2.78	3.57	-1.04

Item 9.127 - Components of Metro Performance and Importance, Cluster 3 (own authorship)



Item 9.128 - Social demographic characterisation of participants per cluster, Metro Transportation (own authorship)

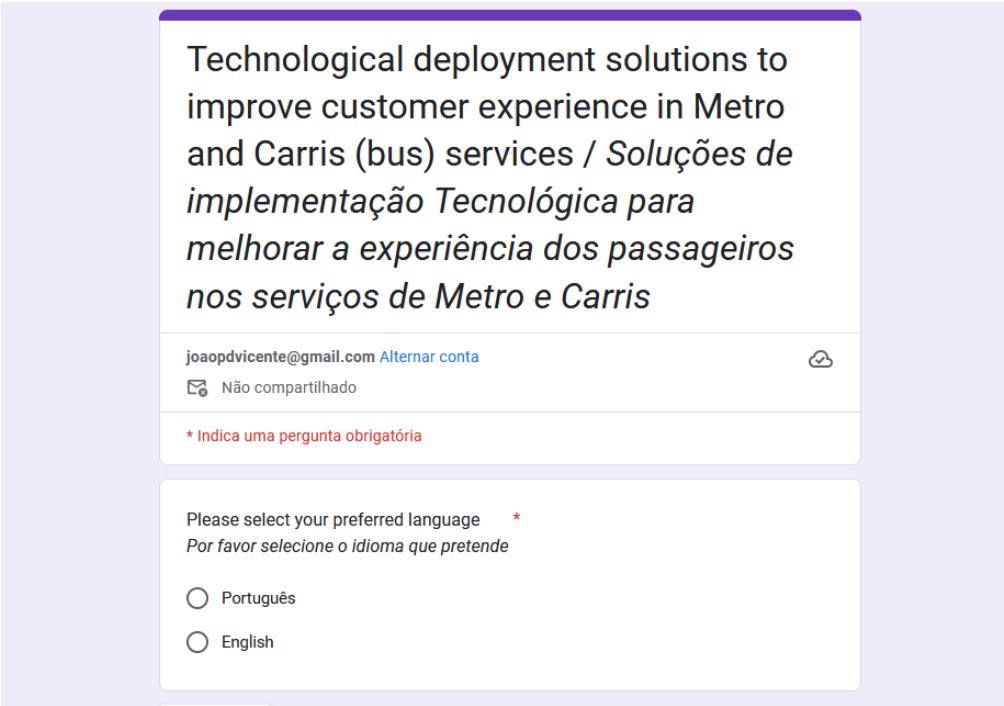
Attributes	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
Time waiting	3.51	3.32	3.70	4.12	3.96	4.29	-0.61
Travel time	3.80	3.63	3.98	4.15	3.99	4.30	-0.34
Punctuality	3.61	3.44	3.78	4.05	3.87	4.23	-0.44
Orientation	4.29	4.11	4.48	4.10	3.88	4.32	0.20
Safety Surroundings	4.00	3.85	4.15	4.17	3.97	4.37	-0.17
Safety Waiting	4.10	3.95	4.25	4.24	4.04	4.45	-0.15
Safety in Transport	3.90	3.73	4.07	4.24	4.03	4.46	-0.34
Security Measures	3.51	3.36	3.67	3.93	3.70	4.15	-0.41
Emergency Reaction	3.02	2.80	3.25	3.95	3.70	4.20	-0.93
Transport appearance	2.98	2.76	3.19	3.44	3.19	3.68	-0.46
Cleanse and Comfort	3.34	3.15	3.53	3.90	3.69	4.12	-0.56
Seamless Ticketing	4.00	3.79	4.21	4.12	3.93	4.31	-0.12
App Accuracy	3.32	3.11	3.53	4.00	3.79	4.21	-0.68
Information at stations	3.66	3.50	3.82	4.15	3.95	4.34	-0.49

Item 9.129 - Results of Metro Performance and Importance, Cluster 4 (own authorship)

Components	**Performance**			**Importance**			**Gap**
	Average	CI 90%		Average	CI 90%		
	3.64	3.46	3.82	4.11	3.94	4.27	-0.46
	4.06	3.88	4.23	4.18	3.97	4.38	-0.12
	3.21	3.02	3.41	3.80	3.57	4.04	-0.59
	3.49	3.30	3.67	4.07	3.87	4.27	-0.59

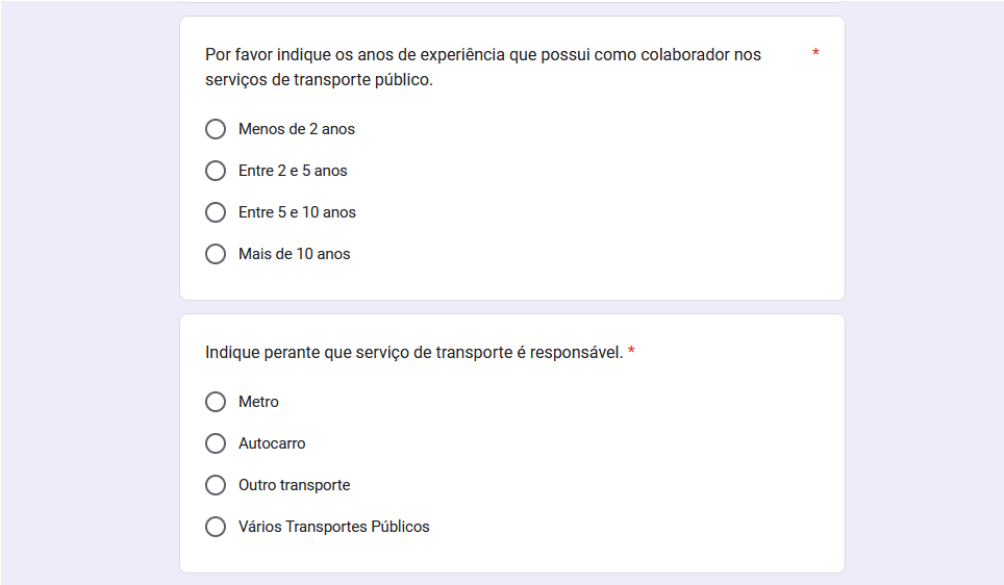
Item 9.130 - Components of Metro Performance and Importance, Cluster 4 (own authorship)

ANNEX H – ONLINE SURVEY PROFESSIONALS

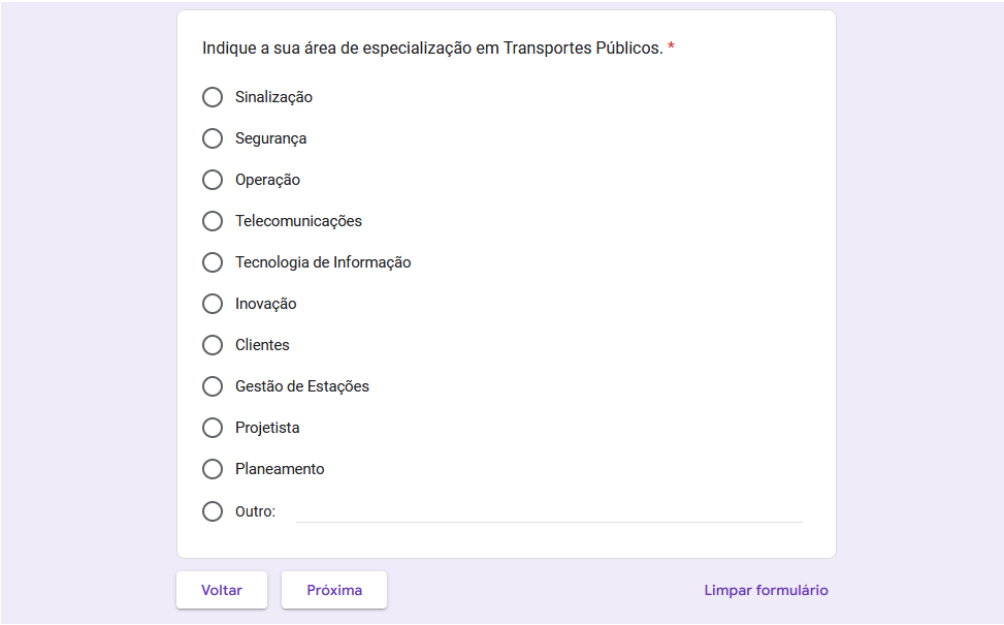


Item 9.131 - Survey Introduction (own authorship)

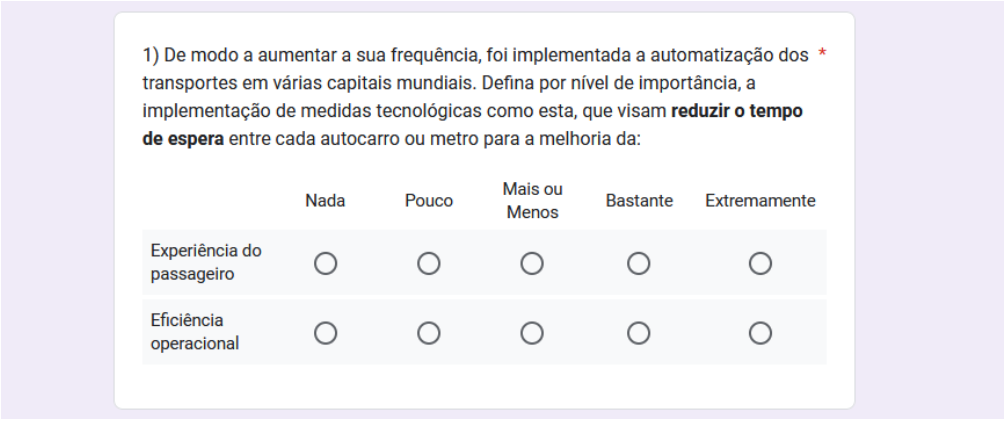
Item 9.132 - Survey Introduction (own authorship)



Item 9.133 -Transportation method (own authorship)



Item 9.134 - Transportation specialisation (own authorship)



Item 9.135 - Improvements of transportation services (own authorship)

2) A automatização do serviço de Metro permite a definição de pontos específicos de entrada e saída das carruagens. Defina por grau de importância, a possibilidade de saber previamente à chegada do Metro, os pontos de **entrada/saída das carruagens** ao longo da linha para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	○	○	○	○	○
Eficiência operacional	○	○	○	○	○

Item 9.136 - Improvements of transportation services (own authorship)

3) A implementação de tecnologia, através de um software mais robusto ou da automatização de certos aspetos do serviço, tem como intuito a **redução da frequência de erros técnicos** que impossibilitam a operação de uma linha de Metro ou rota de autocarro temporariamente. Defina o quão importante considera a implementação de tais tecnologias para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	○	○	○	○	○
Eficiência operacional	○	○	○	○	○

Item 9.137 - Improvements of transportation services (own authorship)

4) Em diversas cidades europeias, é possível verificar o **movimento e real estimativa de chegada** de qualquer transporte que pretendemos apanhar. Em Lisboa esta informação apenas está disponível para serviço de Metro e não para a Carris. Quão importante considera a implementação desta informação para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	◯	◯	◯	◯	◯
Eficiência operacional	◯	◯	◯	◯	◯

Item 9.138 - Improvements of transportation services (own authorship)

5) Defina o grau de importância da implementação de medidas tecnológicas que visam a **redução do consumo energético** dos transportes de Metro e Autocarro, sem condicionar a performance dos mesmos, para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	◯	◯	◯	◯	◯
Eficiência operacional	◯	◯	◯	◯	◯

6) Considerando as aplicações de navegação disponíveis, classifique o nível de importância de se poder visualizar uma estimativa do **peso ecológico** de cada uma das diferentes alternativas de viagem propostas para chegar ao seu destino, para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	◯	◯	◯	◯	◯
Eficiência operacional	◯	◯	◯	◯	◯

Item 9.139 - Improvements of transportation services (own authorship)

7) **A avaliação do serviço e recomendações após utilização** por parte de utilizadores são uma boa fonte de informação para o desenho e operação de serviços de alta qualidade. É possível proceder a esta avaliação através das aplicações de navegação, como a imagem mostra. No entanto não existe forma do utilizador saber de que maneira as suas recomendações contribuíram para o desenvolvimento dos serviços. De que maneira considera importante existir uma maior atenção em partilhar com o passageiro os contributos que as suas avaliações trouxeram, tendo em vista a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	◯	◯	◯	◯	◯
Eficiência operacional	◯	◯	◯	◯	◯

Item 9.140 - Improvements of transportation services (own authorship)

8) Em cidades como Barcelona e Malmö, foi introduzida a **projeção de conteúdo informativo ou didático** em estações de Metro. Como é possível visualizar, nestas estações são projetadas notícias, informações do interesse comum, ou conteúdo para apreciação. Considera esta medida importante para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	◯	◯	◯	◯	◯
Eficiência operacional	◯	◯	◯	◯	◯

Item 9.141 - Improvements of transportation services (own authorship)

9) Certas cidades europeias têm procurado simplificar o processo de **compra e validação de bilhetes de transporte público.** Em Copenhaga, uma vez que não possui torniquetes, é possível adquirir um bilhete virtual previamente, e caso seja pedido, é mostrado ao operador responsável pelo transporte. Indique o nível de importância que a implementação de medidas como estas poderão ter para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	◯	◯	◯	◯	◯
Eficiência operacional	◯	◯	◯	◯	◯

Item 9.142 - Improvements of transportation services (own authorship)

10) Plataformas como a O-CITY têm vindo a implementar a possibilidade de efetuar a **compra e gestão de bilhetes para todos os meios de transporte público** das cidades dentro da mesma aplicação móvel. Indique o nível de importância que a implementação de um serviço como este poderá ter para a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	○	○	○	○	○
Eficiência operacional	○	○	○	○	○

Item 9.143 - Improvements of transportation services (own authorship)

11) Considerando a experiência do passageiro, quão importante consideraria a implementação de medidas tecnológicas que visem a **diminuição de risco de atropelamento** rodoviário e de **quedas de pessoas e objetos** para as linhas de Metro para a melhoria da: *

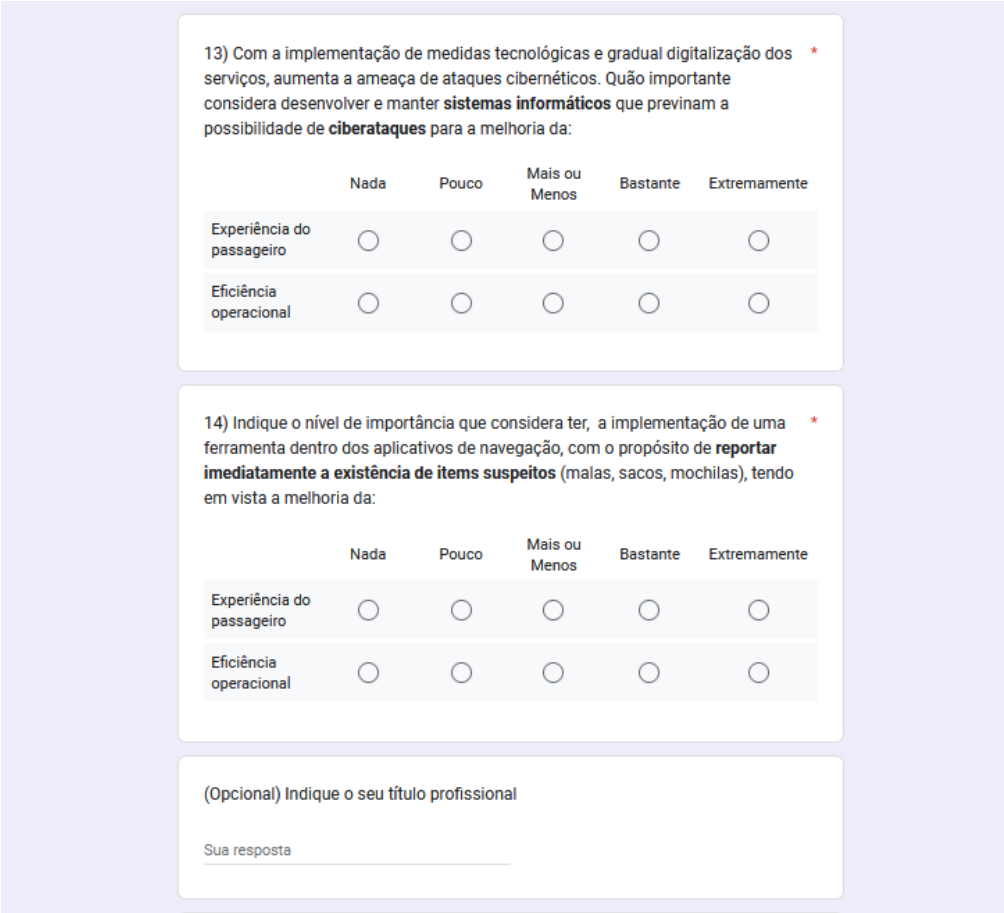
	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	○	○	○	○	○
Eficiência operacional	○	○	○	○	○

Item 9.144 - Improvements of transportation services (own authorship)

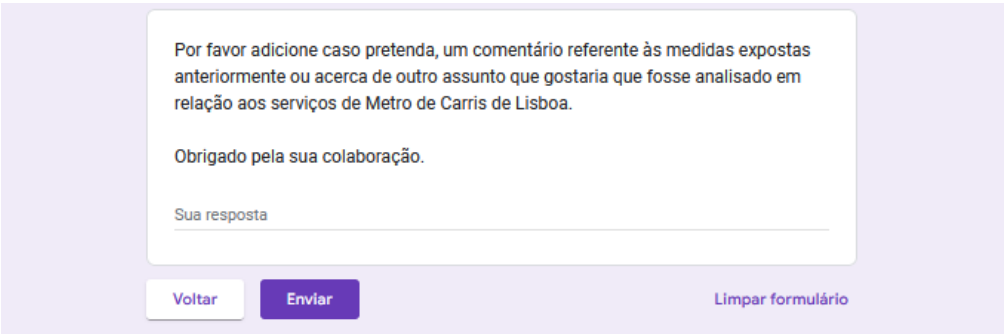
12) Na cidade de Nova Iorque, EUA, existe um aplicativo independente onde é possível analisar e receber **alertas de incidentes** que estão a ocorrer ao vivo pela cidade, devido à partilha de vídeo e mensagens entre cidadãos. Avalie o grau de importância que considera ter, a adaptação deste serviço para áreas perto de paragens e estações em Lisboa, tendo em vista a melhoria da: *

	Nada	Pouco	Mais ou Menos	Bastante	Extremamente
Experiência do passageiro	◯	◯	◯	◯	◯
Eficiência operacional	◯	◯	◯	◯	◯

Item 9.145 - Improvements of transportation services (own authorship)



Item 9.146 - Improvements of transportation services (own authorship)



Item 9.147 - Improvements of transportation services (own authorship)

ANNEX I – RESULTS OF SURVEY TO PROFESSIONALS

Please select your preferred language Por favor selecione o idioma que pretende	Por favor indique os anos de experiência que possui como colaborador nos serviços de transporte público.	Indique perante que serviço de transporte é responsável.	(Opcional) Qual é o seu titulo profissional
Português	Mais de 10 anos	Metro	Engenheiro
Português	Entre 2 e 5 anos	Metro	
Português	Mais de 10 anos	Metro	
Português	Mais de 10 anos	Metro	
Português	Mais de 10 anos	Metro	
Português	Mais de 10 anos	Metro	
Português	Menos de 2 anos	Metro	
Português	Entre 2 e 5 anos	Autocarro	
Português	Mais de 10 anos	Autocarro	
Português	Entre 2 e 5 anos	Metro	Engenheiro
Português	Menos de 2 anos	Metro	
English	Entre 2 e 5 anos	Outro transporte	Project Manager
English	Menos de 2 anos	Metro	
Português	Menos de 2 anos	Outro transporte	Eletricista de eletricos
English	Mais de 10 anos	Metro	Project mgr
Português	Menos de 2 anos	Autocarro	Condutora de autocarro
Português	Mais de 10 anos	Metro	
Português	Mais de 10 anos	Metro	Chefe Núcleo
Português	Mais de 10 anos	Metro	
Português	Mais de 10 anos	Metro	Condutor de autocarro
Português	Mais de 10 anos	Metro	
English	Entre 2 e 5 anos	Metro	
English	Mais de 10 anos	Metro	Director of Board Offce

Item 9.148 - Answers from experts, professional profile (own authorship)

(Opcional) Qual é o seu titulo profissional	Define how beneficial it would be to implement technological measures aimed at reducing the waiting time between each bus and metro.	How beneficial is knowing the entry/exit points of the carriages along the line before the Metro arrives?	Define how beneficial you consider to be, automating the service to prevent the frequency of disruptions.	Please indicate how beneficial you consider to be to have access to the current location and estimated arrival time of any transport you want to take.	Define how beneficial it is to implement technological measures aimed at reducing energy consumption in metro and bus transport.	Indicate the benefit of being able to visualize an estimate of the ecological weight of each of the different travel alternatives proposed.
Engenheiro	5	3	4	5	4	4

	5	3	4	5	4	3
	4	4	5	5	3	3
	5	4	4	4	4	3
	5	5	5	5	5	5
	4	4	4	4	4	4
	4	4	4	4	4	4
	4	4	4	4	4	4
	4	2	2	5	2	4
Engenheiro	4	4	4	5	5	5
	4	5	5	5	3	4
Project Manager	4	3	3	5	3	3
	3	5	4	5	4	4
Eletricista de eletricos	4	5	4	5	2	3
Project mgr	4	5	5	5	5	5
Condutora de autocarro	5	4	4	4	4	4
	5	5	5	5	4	4
Chefe Núcleo	4	4	4	5	3	3
	4	4	4	5	2	3
Condutor de autocarro	2	3	2	4	2	1
	4	3	3	3	2	3
	3	4	4	4	2	2
Director of Board Offce	4	4	4	5	4	2

Item 9.149 - Answers from experts, implementation ratings in importance (own authorship)

(Optional) What is your professional title?	In what way do you think it would be beneficial to pay more attention to sharing the contributions that your evaluations have made for the benefit of the service	How beneficial do you consider to be, the implementation of projection of informative and didactic content at stations and inside transports?	Would you consider that buying a virtual ticket before the trip, and present it to the transport staff would be beneficial for your experience as passenger?	How beneficial you consider it to be, the implementation of a possibility for purchasing and managing tickets for all public transport in cities within the same mobile application.	How beneficial would you consider it to be, the implementation of technological measures aimed at reducing the risk of road accidents and people and objects falling into metro lines?	How beneficial you consider it to be, having an app focused on sharing and receiving alerts of incidents that are occurring live around the city?	How beneficial do you think developing and maintaining IT systems that prevent the possibility of cyber-attacks is?	Indicate how beneficial you think it would be to implement a tool within navigation applications to immediately report suspicious items.
Engenheiro	4	4	4	5	5	3	4	4
	2	2	5	4	4	3	5	4
	3	3	4	5	3	3	3	4
	3	4	4	4	5	4	4	3
	5	5	5	5	5	5	5	5
	4	2	5	5	3	4	5	3
	4	4	4	5	5	5	5	4

	5	5	5	5	5	5	4	5
	4	4	4	4	2	2	2	3
Engenheiro	3	4	4	4	5	3	3	4
	3	4	4	5	5	3	3	2
Project Manager	4	5	5	5	5	5	3	4
	4	3	5	4	5	5	5	4
Eletricista de eletricos	4	4	4	4	4	4	4	4
Project mgr	5	5	5	5	4	5	4	3
Condutora de autocarro	4	2	5	5	2	2	2	2
	4	4	4	5	5	5	4	4
Chefe Núcleo	4	4	5	5	5	3	4	5
	4	4	5	4	4	4	4	4
Condutor de autocarro	4	3	4	4	3	4	4	4
	3	4	4	4	4	4	4	4
	4	3	4	5	3	1	4	4
Director of Board Offce	4	4	4	4	4	4	1	2

Item 9.150 - Answers from experts, implementation ratings in importance, part b (own authorship)