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Demand Responsive Transport Systems: Analysis of potential demand and user preferences

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Resumo

Recentemente, a procura por alternativas ao uso do carro privado tem vindo a aumentar significativamente, não só em Portugal mas a nível internacional, por motivos ambientais, demográficos e sociais. Contudo, o sistema de transportes públicos tradicional tem-se revelado insuficiente para satisfazer esta necessidade. Consequentemente, assistimos a um crescente aparecimento de novos serviços de mobilidade, que visam colmatar as falhas observadas nos modelos tradicionais. Entre eles, os sistemas de transporte a pedido são um dos modelos que se popularizou de forma bastante eficaz, devido às várias configurações que pode assumir e à sua principal característica: flexibilidade. Como tal, grande parte da investigação nesta área passa por avaliar o impacto positivo que estes sistemas podem ter na qualidade de vida dos utilizadores, em particular em pessoas menos autónomas a nível de mobilidade ou residentes de áreas cuja rede de transportes públicos seja deficitária. Esta dissertação tem como objetivo explorar os fatores que influenciam a intenção de uso na população, bem como as características mais valorizadas por futuros utilizadores no contexto português. Para tal, foi realizado um inquérito para obter informação sobre hábitos de mobilidade, ao qual foram obtidas 375 respostas. Analisados estatisticamente os dados, concluiu-se que fatores como área de residência e distância até à paragem de transporte púbico mais próxima impactam a intenção de uso de sistemas de transporte a pedido. Ademais, concluiu-se que a idade, género, ocupação e distância à paragem de transporte público mais próxima, bem como os hábitos de transporte analisados influenciam a perceção sobre as características operacionais.

Palavras-chave: Transporte a pedido; Mobilidade como um Serviço; Transporte público; Mobilidade em áreas rurais e urbanas; Características do serviço;

Abstract

Recently, the demand for alternatives to private car use has increased significantly, both in Portugal and internationally, for environmental, demographic and social reasons. However, the traditional public transport system has proved insufficient to satisfy this need. As a result, there has been a growing emergence of new mobility services aimed at filling the gaps in traditional models. Among these, Demand-Responsive Transport systems (DRT) are one of the models that has become very popular, due to the various configurations it can assume and its main defining characteristic: flexibility. As such, a large part of the research in this area involves assessing the positive impact that these systems can have on users' quality of life, particularly people who are less autonomous in terms of mobility or live in areas underserved by public transport. Thereby, there are several factors that can contribute to the adoption, or not, of these transport systems. The aim of this dissertation is to explore which factors influence the population's intention to use them, plus the characteristics most valued by future users in Portugal. To this end, a survey was carried out to obtain information on mobility habits, to which 375 people responded. The data was analyzed statistically and it was possible to conclude that factors like area of residence and distance to the nearest pubic transport stop influence intention to use DRT. It was also concluded that age, gender, occupation and distance to the nearest PT stop, along with their transportation habits, impact how people perceive operational characteristics.

Keywords: Demand-Responsive Transport; MaaS; Public transport; Mobility in rural and urban areas; Operational characteristics;

JEL Classification: L91 Transportation: General, **C12** Hypothesis Testing: General

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1. Introduction

Transportation has always been a core aspect of the human life. While at first it was only responsible for carrying goods, it slowly progressed into being responsible for people's mobility, enabling the exchange of cultures and ideas. Historically, the evolution of transportation has been very important, being strongly connected to societal and economic progress (Rodrigue J-P, 2024) and ultimately, evolution.

Initially, people could only rely on themselves to ensure their own mobility, so they could only move on foot. Around 8000 b.C, with the domestication of animals, animal traction was introduced and became responsible for moving persons and goods. The second transport revolution took place in 4000 b.C, with the first sailing boats, that would continue to evolve over centuries. The discovery of the wheel, in 3500 b.C, was an important milestone in the history of transportation, because it allowed the speed and efficiency of ground transportation and set the stage for further innovations (Cascetta & Henke, 2023).

The evolution of transportation was a slow-paced process, and it was not until the first decades of the 19th century that this pattern would change, and that transportation would undergo a serious revolutionary transformation. The invention of the steam engine allowed for the reduction of travel times and distances, consequently changing the relations between cities, ports and countries and boosting several other innovations that would later shape the world as we know it today. By the late 19th century, another major invention occurred – the internal combustion engine – that allowed the development of innovative transport means such as the car, but was also responsible for bringing about important evolutions in public transport, enabling the creation of faster and safer vehicles (Cascetta & Henke, 2023). Additionally, with the model created by Henry Ford, a mass production of cars allowed for its democratization, lowering the prices and making them affordable for everyone. Nowadays, we are witnessing the unintended consequences of these developments, that have led to evermore car-dependent cities and villages, affecting quality of life, harming the environment and calling for urgent action (Zero Hour, 2023).

As such, the need for rethinking transport systems is becoming ever more evident all over the world. In Portugal, in particular, the COVID-19 pandemic (Jorge et al., 2013) and the current housing crisis have led to a great number of people moving away from city centers and choosing urban, peri-urban and even rural areas, where cost of living is more affordable (ECO, 2023). However, city centers continue to be the main attractions for services, companies, universities and a great number of citizens must commute there every day.

The overuse of private vehicles is a trend that governments have been long trying to control and reverse, taking active measures to reduce traffic congestion and creating several

incentives to shift towards more sustainable modes of transportation (Navit, 2024; Reis Pereira, 2023). Recently, many political efforts in Portugal have been made to encourage the reduction of the individual car, such as free or reduced-price transport passes (DECO Proteste, 2024), forbidding the entrance of vehicles in main city centres – such as Lisbon (Automóvel Club de Portugal [ACP], 2015), Porto (ANTRAM, 2021) and Guimarães (TSF, 2023), as well as a growing investment in public transport policies (ECO, 2023; Jornal de Negócios, 2024). Despite such efforts and incentives, private vehicles remain, by far, as the primary means of transportation due to the lack of other reliable and effective alternatives in Portugal (Público, 2022, 2023). According to Instituto Nacional de Estatística (INE), the percentage of people using their private car as the main source of transportation has increased in the last decade, being now 66% (INE, Pordata, 2023).

Additionally, we are witnessing a growing awareness about the perks of using public transport for public health, financial and environmental reasons. Citizens nowadays also show greater concerns with choosing mobility options that are more environmentally friendly, such as walking or biking and using public or shared transportation, as well as opting for electric vehicles (Revista Sustentável, 2024). However, such choices can only be done if they are provided with good services that satisfy their needs. While traditional public transport systems are indeed more sustainable – such as buses, trains and metro – they are not enough to cover all passenger's needs, since they are not equally distributed across regions, favoring city centers and more populated areas and such is the case in Portugal. (Público, 2023).

In Portugal, the majority of transportation services are offered by public buses, since metro is available only in the two largest cities of the country, Lisbon and Porto, and the railway service is very deficient, being mostly concentrated on the coast. As such, there is a great number of areas that are severely under covered by public transportation, and an alternative solution to reduced private transportation is needed (ECO, 2023; Público, 2023). In fairly populated cities, as Lisboa, Porto, Gaia or Braga, residents are dissatisfied with the overcrowded vehicles during peak times, along with excessive waiting times and unreliable schedules (SIC Notícias, 2024). Furthermore, the available public transport buses lack sufficient routes due to the difficulty in ensuring the maximum capacity for larges vehicles. This often results in trips that are not justified by the extremely low volume of passengers, leading to a significantly reduced number of schedules. Another issue that arises from using larger vehicles is the impossibility of reaching locations where the geographical characteristics hinder their passage (RTP, 2023).

To increase the potential of public transport services and inspire people to rely more on it, the offer of public transport, and especially, bus services has to gain more flexibility to overcome its current weaknesses and respond better to the needs of citizens.

Demand-responsive transportation (DRT), also known as micro-transit, paratransit, dial-a-ride, and many others (Volinski, 2019), is a mobility solution that can take on several forms, but it is essentially known for its flexibility and adaptability to the passengers' needs, and the use of smaller vehicles. Instead of operating according to fixed routes and schedules, it works on demand, aggregating various trips with similar destinations. Despite the first DRT publication dating back to 1985, it was not until 2006 that the subject started to gain an increased attention by researchers. With the development of technology, these transport systems have started to gain popularity since it became possible to better optimize routes and schedules and in 2020, there was a remarkable growth in the number of published articles on the topic, that continues to expand (Schasché et al., 2022). Although it was originally thought to tackle the lack of efficient transport provision in low-density areas, DRT systems have also been proving efficient in urban and peri-urban areas, as a way to fill in the gaps in already existing transport systems (Sörensen et al., 2021) and provide an alternative to the use of private cars (Dauer et al., 2024).

Even though there is now a growing number of research regarding DRT, it is also interesting to state that, as it first emerged as a solution oriented mostly to tackle mobility issues in rural areas, most of the existent literature focuses on case studies of specific non-urban regions (López-Iglesias et al., 2018). When it comes to target groups, it is believed to be a solution especially beneficial for less mobile people, like the disabled, children, or elders (Kersting et al., 2021; Knierim & Schlüter, 2021; Ranković Plazinić & Jović, 2018). Besides, there is also a dominance of mathematical and economic issues dominating DRT research, with socio-scientific studies being notably scarce and a focus on ecological advantages is rarely mentioned (Schasché et al., 2022). Regarding personal factors that could influence the use of DRT systems, there is a lot of discrepancy in findings, appearing to be dependent on other external factors (Schasché et al., 2022).

All over Europe, several Demand Responsive Transport models have been tested through pilot projects and implemented later when efficient (Dauer et al., 2024). Portugal is now taking the first steps into this mobility service, with a few municipalities testing it, with a special focus in least populated areas. Portugal qualifies as one of the countries that would benefit a lot from having these types of transport systems, since it has great deficiencies in its public transport services all over the national territory and an aged population (GEOTA, 2020; Público, 2023).

The present research is motivated by the lack of consistent evidence regarding what makes Demand Responsive Transport systems attractive, since to the author's knowledge there is no published study on potential users' characteristics affecting the perception of Demand Responsive Transport systems operational characteristics and people's intention to use such services in Portugal.

1.1. Objectives

The main goal of this dissertation is to assess whether users' sociodemographic characteristics and transport habits can affect intention to use DRT and the perception of its operational characteristics. To reach this objective, two research questions are posed to answer in this thesis:

1. What socio-demographic characteristics and transportation habits affect intention of use?
2. What socio-demographic characteristics and transportation habits affect the perception of DRT operational characteristics?

1.2. Methodology

To achieve the objectives previously mentioned, a combination of approaches has been developed with a mix of qualitative data that explored the features of DRT and a quantitative online survey that allowed to collect data on sociodemographic characteristics, transportation habits and satisfaction with current public transport systems. The survey also included a brief explanation about demand-responsive transport systems and questions to assess the intention to use such system and the main relevant characteristics. The qualitive approach used initially had the main objective of helping build the survey, which is the basis of this investigation.

1.3. Thesis Outline

The structure of this work is divided into seven chapters. The first chapter aims to present the problem that motivated this research, presents its main objectives and summarizes methodology used to achieve them.

The second chapter focuses on presenting relevant work done in this field, and goes in depth about travel well-being, the concept of DRT systems, their characteristics and how they contribute to sustainable mobility.

The third chapter focuses in detail on the methodology followed in this work. Firstly, it explains the qualitative approach and its contribution to the design of the quantitative survey. Secondly, the quantitative survey is described.

Chapter four begins by presenting the statistical results of the survey. Then, a statistical model is presented.

Finally, the main results are discussed and compared with the literature in chapter five.

The sixth chapter summarizes the final conclusions of this dissertation and the seventh chapter concludes this work by stating the limitations of the investigation and giving suggestions for future work.

2. Literature Review

The connection between travel and well-being has garnered significant attention in recent years, as mobility plays an extremely important role in modern life. The well-being deriving from travel, often referred to as “travel well-being” or “commute well-being”, plays a critical part in shaping overall subjective well-being. Understanding how travel well-being contributes to enhance subjective well-being is essential to design transport systems that further improve quality of life. With this in mind, demand-responsive transport systems have come to take an important step in this direction, providing a mobility solution that fulfils the needs of the passengers’ that current public transportation isn’t yet able to fully satisfy, thus improving their overall quality of life. Nevertheless, the utility of DRT systems is influenced by a wide variety of factors, such as socio-demographic characteristics, geographical settlements and mobility preferences and needs. Exploring these factors can help understand how DRT systems can be differently perceived and offers valuable insights that can help improving such systems and ultimately, enhance subjective well-being and quality of life.

2.1. Travel and Commute well-being

Transportation is an absolute crucial part of people’s lives, since it is accountable for people’s mobility. Whether it is done by car, bus, train, cycling or walking, transport modes have proven to be intricately linked to the improvement of well-being (Prinzing et al., 2024), the economy, society and communities. Therefore, various authors, as mentioned forward, have dedicated their research to the impacts that travel can have on subjective well-being (De Vos et al., 2013; Rossi et al., 2023). Accordingly, mobility is fundamental in providing an active lifestyle, since it relates to the ability to exercise, to socialize and to keep autonomy and independency, especially to older adults and elders (Banister & Bowling, 2004; Gagliardi et al., 2010; Metz, 2000; Siu, 2019).

One of the most evident impacts are the feelings that travellers may experience during their trip (Ettema et al., 2011; Zeid, 2009). Many authors state that transport mode and trip characteristics play an important role in this (Zeid, 2009). There is a consensus in literature regarding how active mobility, such as cycling and walking, positively contributes to a higher travel well-being. Engaging in daily physical activity, balancing personal and professional life (Zeid, 2009) and reducing emissions are the most stated reasons why these transport modes directly impact individual and public health. People who opt for active transport modes also report lower levels of stress when traveling (Lancée et al., 2017).

Considering public transport trips, travel mode choice is directly related with travel well-being - when passengers can use their preferred transport mode, travel well-being tends to be

higher (Lancée et al., 2017). However, when trips are done using public transport, trip characteristics are important aspects to take into consideration (Khaleghi & Kato, 2023). Flexibility, frequency, time of the trip, safety, perceived quality of the service, lack of multi-modal integration and reachability are the factors mentioned throughout travel well-being literature that influence passengers travel well-being the most (Zeid, 2009).

Assessing travel well-being when using a private vehicle is not as linear as other transport modes. There is a clear preference for this form of transport, especially when it comes to lower density areas, where there are few objections to the use of the car, and it allows higher levels of comfort and flexibility, contributing to higher travel well-being. However, when traffic congestion and difficulties in parking become a reality, a lot of users' report having higher levels of stress due to time and difficulty in commuting, and some even report a negative impact on activities performed after the commute (De Vos et al., 2013; Zeid, 2009).

Another important way in which travel contributes to well-being is how people use the time they take to travel. It was found that travellers who spend their commuting time performing relaxing and entertaining activities presented lower levels of travel well-being than those who engaged in social activity, most likely due to a failed attempt of fighting boredom (De Vos et al., 2013).

The other three reported ways in which travel affects well-being are related to activity participation enabled by travel, trips where travel is the activity and potentially the travel itself (De Vos et al., 2013). However, this work focuses mostly on the ones above mentioned.

2.2. How travel related well-being contributes to subjective well-being

Subjective well-being, satisfaction and happiness are three concepts that researchers recurrently used interchangeably, regardless of the study field, that relate to an overall experience of pleasant emotions in all aspects of one's life or within a specific domain (Diener, 1984). Subjective well-being is a complex concept that, simply put, can be defined through two different philosophies: hedonism and eudaimonism. The first perspective focuses on utility, satisfaction with one's preferences and happiness (Singleton & Clifton, 2021) and it can be evaluated by the presence of positive feelings, the absence of negative feelings and overall satisfaction with life. The latter, however, relates to a cognitive dimension.

The relation between subjective well-being and transport has been a subject of study for the past decades, but it has increased significantly since the link between travel behaviour and subjective well-being has been proved. According to (De Vos et al., 2013) there are at least five ways in which travel can affect well-being:

1. Feelings experienced during the travel (positive and negative)

2. Participation in activities enabled by travel
3. Activities performed during the travel
4. Trips where travel is the activity
5. Motility (people's capacity of becoming mobile – related to independence and confidence).

When analysing travel well-being literature, is possible to conclude that most studies only consider measures of hedonic well-being and that this bias happens due to a strong association of travel to utility purposes. Gaps in literature point out to the fact that most research that has been done on this field is in light of a biased hedonic understanding of well-being, even though travel well-being is much more than travel satisfaction and affect and that the activities that mobility enables people to undertake can lead them to a feeling of achievement and purpose in life, thus contributing to the overall subjective well-being.

It is also important to take into consideration that well-being is a very subjective matter, so it can be preferable to evaluate how people feel about a certain aspect or feature, rather than the feature itself and this is applicable to transport well-being as well (De Vos et al., 2013).

However, it isn't just the dimensions of travel subjective well-being that have been discussed in the literature, but also how they are measured. For instance, there is an important distinction between real-time measures and retrospective measures. One has to do with immediate reports of respondents in their normal surrounding, while the other focuses on more traditional surveys, asking respondents to evaluate previous activities. The most common practice in studies of the area is the traditional retrospective approach, due to the availability of participants (Prinzing et al., 2024) .

One way to measure travel-related well-being is through travel satisfaction – a cognitive measure that assesses the overall satisfaction with travel and travel affect – an affective measure that focuses on the emotions experienced during the travel (Mouratidis et al., 2023).

Travel satisfaction can be described as "travellers' cognitive evaluation of the quality of the travel" (Y. Wang & Gao, 2022) and tends to focus on customer satisfaction, prioritizing the evaluation with the service and its features, including pricing, punctuality, cleanliness, accessibility and others.

Travel affect has begun to being measured in travel well-being research, since it relates to travellers' emotions, feelings and moods provoked by the travel experience itself (Singleton & Clifton, 2021). The most common way of measuring it is through retrospective questions and quotes regarding emotional sensations, that are evaluated in a Likert-type scale (Zeid, 2009).

These questions must include factors that can directly affect travel experience, which usually are trip attributes, such as purpose, time, distance, safety, companion and mode (Khaleghi & Kato, 2023).

2.3. Demand-responsive transport systems

Demand-Responsive Transport System – also known as Demand-Responsive Transit System or Demand-Responsive Transportation Service – is a shared mobility option that has been gaining increased popularity in the last decade, operating as a solution regarding the lack of transport provision and flexibility offered by traditional transport systems. Implemented in several countries around the world, their positive effects on transport well-being are evident, especially when it comes to less mobile people, such as children, elder, disabled people or those uncapable of driving.

The concept of Demand-Responsive Transport (DRT) first emerged in Atlantic City in 1916 when jitneys were introduced to cater to public ride requests. However, due to the intense competition these services posed to the already well-established trolley systems, traditional transit authorities-imposed restrictions, requiring jitneys to follow fixed routes. This led to a decline in their significance by the 1920s. DRT experienced a resurgence in the 1960s, coinciding with the expansion of low-density areas across the United States. (Deka et al., 2023).

Before 1980, DRT faced challenges such as high operating costs, slower speeds, and higher ticket prices, leading to the downfall of many DRT initiatives (Deka et al., 2023). Although the 1980s and 90s brought technological advancements in communication and data collection, paratransit services were typically categorized as either low-tech or high-tech. Even with the rise of internet technology in the early 2000s, DRT struggled to gain acceptance as a mainstream transportation alternative and was viewed as inefficient and economically unfeasible (Deka et al., 2023). Over the last few years, supported by technological advancements, DRT systems have grown in popularity.

Although there is not yet a consensus among scholars regarding its definition, there is one main characteristic that describes these types of systems, and that's the fact that they respond to actual user demand (Schasché et al., 2022). The difficulty in finding one standardized definition is due to the fact that their operational, functional, technological, economic, and institutional features may differ significantly (Freiberg et al., 2021), leading to some authors calling it the "chameleon of the public transportation world" (Volinski, 2019). Adding to this, these systems find themselves undergoing constant transformation. Even so, various authors have tried to define DRT systems. Some describe it as a service that can use various means of transport, and for which the fare is charged based on the passenger and not the vehicle (Wang et al., 2015), while others focus on the flexibility of its routes and timetables (Berrada & Poulhès, 2021; Mehran et al., 2020). However, the most common and less compromising definition is "an intermediate form of public transport, somewhere between a regular service

route that uses small low floor buses and variably routed, highly personalized transport services offered by taxis" (Brake et al., 2004).

2.3.1. Operational characteristics

As stated above, DRT systems can assume various operational configurations, thus they shall not be perceived as a standardized transport mode, but rather a mobility solution that adapts to the specificities of the regions they operate in and the needs of the population they will serve. Taking this into account, there's a hardship in the literature to unify a set of characteristics that designate these systems and different authors tend to use different approaches to do so (Dauer et al., 2024). Despite this difficulty, it is possible to gather some of the most important ones, in the several forms they can appear, through pilot projects and case studies.

Flexibility is the determinant feature that characterizes DRT, since it is the main factor that distinguishes these systems from the traditional transport services and is accountable for determining the levels of freedom or restriction of the itineraries. Consequently, there are different flexibility levels that can be found in already implemented services (Freiberg et al., 2021). Fully-flexible DRT schemes are considered the true "door-to-door" services, where passengers can choose their pick-up and drop-off points and the routes and schedules adapt completely to the user's needs, such is the case of the EcoBus, in Germany (Kersting et al., 2021). Semi-flexible systems, on the other hand, are even more complex to explore, since they go through a wide range of possibilities and alternative designs, adapting to the needs of the areas served (interview to Intermunicipal Communities - CIM). Certain operators provide route-deviation services, where they maintain a pre-defined route, but allow for small deviations and passengers can be picked-up and dropped-off at designated locations, as long as they are located within a certain area (Freiberg et al., 2021). Another possibility is to have specific destinations but allowing numerous different routes to accommodate all the passenger's points of pick up – common when the service aims to connect to other transport modes or city centers, for example (Papanikolaou et al., 2017). Besides route flexibility, it is also important to mention that there are no fixed timetables. In fact, some of these services operate during day and night, even though the majority of them opt for being available only on weekdays and during a specific time window (Freiberg et al., 2021).

Regarding service scheduling, a trip can be booked for any time, as long as the service is running. However, most services require a pre-booking that can go for 12h or 24h prior to the time of the travel. The majority of the bookings can be done via mobile apps or websites, nonetheless, bookings via phone calls are always available, so that no technological skills are required in order to take advantage of the service (Drake & Watkins, 2024; Kersting et al., 2021; Knierim & Schlüter, 2021).

DRT uses a wide fleet of available vehicles to operate its services, both human-driven and autonomous vehicles (Gössling et al., 2023). Since its main objective is to cover for flaws in the traditional transport system – characterized by high capacity buses, many times, used under its capacity – the service is commonly operated by smaller vehicles, such as mini-buses or taxis, usually ranging between four to sixteen seats. The smaller size of the vehicles brings about several advantages, since they are easier to maneuver and allow the access to areas where larger vehicles can't reach. Additionally, these types of vehicles are less costly to operate, both because they are more fuel efficient, but also due to the fact that drivers don't need commercial driver license (Volinski, 2019). Accessibility is also a major concern when designing DRT systems, since it was originally targeted at people with reduced mobility. Consequently, these vehicles tend to have features that allow to receive people who lack mobility (Alcocer et al., 2018), such as low entry, standing height and space inside the vehicle (Kersting et al., 2021).

The price of DRT varies widely depending on the fare scheme. Some services have fixed-costed fares, though some discounts can be offered, depending on the age or socio-economic status of the passenger; others charge per trip or per route, depending on the distance; and some even offer the service free of charge, for eligible user groups, most commonly in rural settings (Dauer et al., 2024; Freiberg et al., 2021). However, when operated by public services, the prices are accompanied by the regular public transport fares in the region, without any additional costs (Freiberg et al., 2021).

Technological integration was the propelling factor that has led to the development and dissemination of DRT systems, fundamentally transforming the way these services operate, how they interact with users and how they are managed. The advancement of technology has allowed DRT to become more efficient, user-friendly and scalable, making it possible to compete with traditional transport systems and cover the needs of urban and rural transportation. Mobile communication, GPS (Global Positioning System) tracking and real-time data processing were the key factors that have been contributing to the growing success of these systems, that can now more easily and rapidly match supply with demand and facilitate the optimization of routes (Melo et al., 2024). The importance of the operational characteristics is determinant, there so it is the basis for the hypothesis that have been tested thoughout this research:

H3: There is a significant difference in the perception of operational characteristics between individuals with different sociodemographic characteristics.

H4: There is a significant difference in the perception of operational characteristics between individuals with different transportation habits.

2.3.2. DRT systems differentiation based on geographical coverage

DRT systems differ significantly in their primary goals depending on the service area they are operating. As such, it is possible to identify three main areas that can benefit differently from these services: urban, suburban, and rural.

DRT in urban areas is still an underdeveloped theme in the literature, since only recently some authors have started to state that the success of DRT systems is higher in areas that previously had a fairly developed public transport system (Sörensen et al., 2021) and that these systems are more likely to prove sustainable in areas with large transit dependent populations and high population densities. In these cases, DRT systems mainly offer last-mile connections or services during off-peak hours, when frequency of public transport is lower (Dauer et al., 2024).

Even though peri-urban areas receive little attention in the literature, they have started to be seen as a “dynamic and multifunctional territory” and not only a space between urban and rural areas (Thao et al., 2023). However, cities continue to be important centres where services, jobs and social activities remain concentrated, becoming, therefore, absolutely crucial to ensure good transport connections to and from surrounding areas. DRT can thus offer a solution to where public transit is less frequent, and guarantee good connections to main transit corridors, acting as “feeder services” (Dauer et al., 2024; Thao et al., 2023).

DRT systems were originally thought to work as a solution to tackle the issues of a deficient transport provision in rural areas. Poor public transport services can be identified by “a lack of public bus/rail-transit station proximity/long walking distances and poor satisfaction with existing services" (J. Wang et al., 2023). Many studies have found that mobility and quality of life are intrinsically connected, as explored in 2.1. and 2.2., and this becomes even more evident in rural areas, especially for groups of individuals who are less mobile, such as elders, children and disabled people (Kersting et al., 2021). Throughout the literature, several problems regarding rural mobility were consistently mentioned, that is why testing the following hypothesis was essential:

H1: There is a significant difference in the intention to use between individuals with different sociodemographic characteristics.

2.3.3. Personal, geographical and mobility aspects affecting the utility perception of DRT

Lack of transport provision is the main issue that is repeatedly mentioned in the literature (Truden et al., 2022), together with lack of flexibility (Sörensen et al., 2021). These problems emerge from the traditional transport system, that, most of the times, have fixed routes and

timetables that do not meet the citizen's needs (Knierim & Schlüter, 2021). Frequently, this causes a mismatch between the times people need to use public transportation and the scheduled routes.

Price is also often referred to as a problem, both for policy makers – that don't believe investments in rural mobility make any economic sense (Flipo et al., 2023), – as for users, that don't believe the price of bus tickets to be fair (Berrada & Poulhès, 2021), given the perceived low quality of the transport services they are offered, resulting in an unattractiveness towards the transport system (Schasché et al., 2022) and an increased car dependency. The fact that these regions usually concentrate less population, and they are sparser, also represents an additional challenge to traditional public transport, that usually tries to mitigate the problem offering longer routes in order to cover all areas, which is not an optimal solution, since the time of the travel is a major concern for the users (De Vos et al., 2013). However, it is crucial to acknowledge the changes in mobility patterns in the last decades. On one hand, an increasing share of older people want to remain active and independent, a trend that didn't occur for the previous generations. Considering that many aged individuals tend to stop driving, on average, between seventy and eighty-five years old, for medical reasons or others, it is vital to provide them with the necessary means to maintain their autonomy. At the same time, the remaining older population still requires a transport system that allows them to go to the doctor, shopping or any other essential appointments (Kersting et al., 2021). When discussing the well-being of less mobile people – children, teenagers, elders and disabled people – DRT systems have proven to be very effective in tackling the matter of isolation, loneliness and social exclusion that these groups may experience (Ward et al., 2018) since, shared journeys can lead to the opening of social spaces, providing not only relevant connecting services but also having a rich social contribute (Kersting et al., 2021). On the other hand, studies have also shown that there has been a growing number of teenagers that do not have, nor have any intention of having, a driving license (Ward et al., 2015), reinforcing the urgency of having reliable and sustainable mobility solutions. There so, it is important to test if:

H2: There is a significant difference in the intention to use between individuals with different transportation habits.

When analysing DRT pilot-projects, is possible to observe that nearly all participants were happy with the experience (Kersting et al., 2021) and their perception of the quality of the public transport service had improved, when aspects like flexibility, accessibility, affordability, safety and comfort were secured. This was common to all ages and social groups across several pilots (Bruzzone et al., 2021; Volinski, 2019).

More interesting findings emerge when testing the level of acceptance of the various DRT systems. In older people, for example, it was found that women are more open to these types of systems, since, in many cases, the impossibility of driving a private car is associated with a feeling of incapacity for men. However, if autonomous transport services are part of the solution, then the level of acceptance completely shifts and there is a higher acceptance from men rather than women (Gössling et al., 2023). Notwithstanding, one can conclude that older people are much more open and positive regarding flexible public transport schemes than expected (Kersting et al., 2021). Nevertheless, DRT systems should still take into account some limitations that may come up when designing them. These are systems that have been developing fast relying on technology, but it is crucial to take into account that not all of its customers may be acquainted with such technologies and the way they operate (Gössling et al., 2023). As such, it is crucial that alternatives and solutions with which they are familiarized are offered, such as call-centres, that have proven to be effective in complementing the service and make it become more intuitive (Sörensen et al., 2021).

Therefore, it is easy to understand why multiple papers highlight the urgent need to transform the current transport system into a more flexible, accessible and on-demand one, characteristics observed in DRT systems.

Overall, DRT systems prove that even though different groups of people require specific needs and have distinct motivations, it is possible for them to benefit from the same service (Papanikolaou et al., 2017). It is, however, important to point out that DRT systems do not aim to replace public transport as we know it, but to complement it and possibly attract new customers (J. Wang et al., 2023).

3. Methodology

The methodology of this work is a combinations of a mixed methods approach, meaning that qualitative and quantitative data are used to achieve the objectives. Even though the focus of the analysis is regarding quantitative data, a qualitative approach has been conducted firstly to collect data that allowed to gather best practices from some Intermunicipal Communities, later used in the construction of the survey.

In particular, the qualitative approach was used in order to collect data from municipalities regarding their current transport systems and to explore the potential of this new transport service through the lens of the Municipalities, by interviewing Intermunicipal Communities on the functioning of DRT systems in Portugal.

Secondly, a survey was designed aiming to obtain quantitative data from citizens regarding demographic and mobility factors that can affect how people perceive DRT systems, their characteristics and intention to use the service.

This chapter is divided into four subchapters. The first and second subchapter, refer to the qualitative approach, and include some highlights stated as they were essential for the definition of the methodology, and the construction of the survey, described on the third subchapter. The third subchapter explains the basis of the survey and its four sections: socio-demographic characteristics, transportation habits, travel satisfaction and intention to use DRT. The last subchapter focuses on how the data obtained was collected and analysed.

3.1. Choice of location of study

The first approach to this work was qualitative and aimed to gather information regarding how local authorities and citizens feel towards the current transport system and if DRT systems can work as a solution in rural areas, as stated in the literature.

The primary goal of this work was to investigate how DRT systems could improve the quality of life of people living in rural areas (Kersting et al., 2021) through an interview (Appendix A.1) to the municipality of Paredes de Coura. As such, information regarding how local authorities and citizens felt towards the current transport system, and how satisfied they were with their means of transportation, was needed. In order to fulfil this requirement, an interview with the head of the transport department of the municipality was scheduled. It was obvious that Paredes de Coura had a true lack of transport provision and, weren't for the public transport being integrated with school buses, none of the nine routes currently available – five municipal and four intermunicipal - would be financially viable (Interview to the CMPC – Câmara Municipal de Paredes de Coura).

According to the head of the transport department, the population of this municipality "does not have the need for a public transport system". Even though the responsible recognizes a

prior use of transport services across all ages, she also states that that is no longer the reality. Nowadays, even less mobile people, and in particular, old people, have the monetary and social means of finding other solutions, such as arranging shared taxi-rides with neighbours or catching rides with relatives or friends. The responsible had numerous examples of transport initiatives that have failed to survive due to lack of interest from the population. Two of these examples were the implementation of three extra bus routes during the months of July and August so as to allow children and young teenagers to get to the centre of the municipality and participate in several activities organized during this period – "the number of passengers during both months was zero"; another initiative was more oriented to older and less mobile people, and it consisted in "creating mobile health units, that would go to each locality and do health check-ups, like exams or medical appointments that otherwise had to be made in the nearest health centre". Also zero was the number of patients that ever benefited from this service, stating and proving that "residents preferred and had the means to travel to the nearest health facility".

As these were statements that were not corroborated by the existing literature (Gössling et al., 2023; Kersting et al., 2021; Knierim & Schlüter, 2021; Ranković Plazinić & Jović, 2018), and to ensure the reliability of the testimony and understand the reasons of the Portuguese specification, a focus group with 10 participants (Appendix A.2), aged between 20 and 75 years was conducted online, allowing to discuss about transport options and how happy they were with them. The findings that arose from this discussion proved to be in line with the reality depicted by the head of the transport department. Even though all participants were critical and aware of the lack of transport provision and flexibility, some of them didn't show any availability to trade-off their car by any type of public transport. These were the main reasons why:

"Whenever I travel somewhere, I take the opportunity to do several things, like going to a Pilates class, the supermarket and the bank. There is no public transport that allows me to do all of those within the timing and comfort I need. Also, I would always prefer my car because I need to have the space to carry the things I need with me."

Woman, 54 years old

"My job would never allow me to use public transport because I never have a fixed route, meaning that I would always need the car to meet my schedule and destination requirements."

Man, 64 years old

"Even though I don't drive, I have always managed to get to work with the help of co-workers, family or neighbours and it is more convenient and pleasant to me that way."

Woman, 45 years old

"I don't see myself using public transport unless it was for a very specific event, where the use of the car would come with some setbacks such as great difficulty in parking."

Man, 32 years old

The participants chosen to take part in the discussion all had different backgrounds, occupations and socio-economic positions and two of them did not have a driving license (which is a difficult characteristic to find in such rural settlements). Even so, all agreed that, even if there was a good provision of public transport that met their needs, there were low chances that they would opt for it.

Due to the results perceived and considering the lack of interest from public institutions, transport operators and residents themselves, and being the social part of this research out of the scope, it was decided to carry out the research in a different context. Nevertheless, the summary of the insights has been essential to include and define two parts of the survey: "Travel mode until public transport stop" and desired "DRT characteristics".

Supported by recent literature on the field, stating that DRT systems prove to be more effective as a complement to an already existing public transport system, rather than existing on their own (Sörensen et al., 2021), this research continues on a broader scope, to see if there are relevant differences regarding intention to use, depending on the citizens' sociodemographic characteristics and transportation habits.

3.2. Intermunicipal Communities Interviews

This part of the research aimed to gather qualitative insights and best practices from the few projects implemented nationally, to help filter the main objective and design the quantitative survey, motivated by the limited academic focus on DRT systems in Portugal. This was essential, complementarily to the literature and the focus group, to define what DRT characteristics should be evaluated on the quantitative survey.

In order to achieve this, e-mail questionnaires were sent to all Intermunicipal Communities (CIMs) in Portugal. These questionnaires (Appendix A.3.) sought to understand the regional characteristics of transport provision, the presence of financial incentives for sustainable mobility, and the initiatives and attitudes of institutions and citizens towards transitioning from traditional transport systems.

The responses obtained led to the finding of three CIMs – Médio Tejo, Lezíria do Tejo and Viseu Dão-Lafões – that had already implemented flexible transport systems. The next step

was to investigate under what circumstances and conditions these services could be requested and how they were being received by the users.

Despite being in different stages of implementation – with Médio Tejo having the service for five years now, and Lezíria do Tejo only recently launching its service, all three services emerged from the common need to supplement an already existing, yet deficient public transport provision.

The primary objective of these services is to address gaps in traditional public transportation, by facilitating connection within municipalities, linking peripheral areas to municipal centres and, in case of Viseu-Dão-Lafões, ensuring additional connections to regional train stations. Furthermore, they are designed to operate as shared transportation, optimizing routes and schedules to accommodate the needs of multiple passengers simultaneously, enhancing sustainability while offering a more practical solution for the community.

As such, these systems operate under specific conditions: they require prior booking by passengers before 12.30pm the day before the intended trip; bookings are made via a free phone call and passengers must provide details such as departure and arrival times, destination and the reason for travel; the service operates solely under the condition that no other public transport route can meet the passenger's needs and is provided by local taxis with a capacity of four to eight passengers; the fares are aligned with standard public transport prices, ranging from 0.75€ to 6.60€, depending on the distance. However, it is noteworthy that these services do not yet operate as fully door-to-door systems, as passengers must use designated pick-up points.

Overall, these DRT systems have been successful in addressing the deficiencies of traditional public transport by catering to the specific needs of the local population. However, an unexpected finding emerged from the Lezíria do Tejo CIM, which reported that "[our] most isolated and underserved area in terms of public transport was also the one that hasn't yet required our services". This might happen because there is a clear preference for the use of the car and, under true rural settlements, it improves significantly their quality of life and in a way that even DRT systems can't compete. However, it also very important to have in mind the role that community plays in such regions, and further transport studies should approach the social component both for the need and level of acceptance in these truly rural settlements. This outcome, aligned with the previous statements retrieved from the focus group, reinforces the importance of considering societal factors when designing and implementing transport policies.

As stated, the information extracted from the questionnaires proved to be relevant for the design of the survey, in particular to include "travel mode until public transport stop" and to

assess what characteristics could make people more interested in using this service ("operational characteristics").

3.3. Survey design (Quantitative approach)

As in many similar studies regarding the potential of DRT and its impacts on travel well-being (Kersting et al., 2021; Knierim & Schlüter, 2021; König & Grippenkoven, 2020; Pak et al., 2023; Zeid, 2009), a survey was designed in order to identify in which ways the implementation of a DRT system, integrated in the already existing public transport system, could cover the transport needs and improve the quality of life of residents living in rural or peripheral areas (Thao et al., 2023).

The present study was carried out using a non-probability sample collected for convenience using the snowball technique. This sampling technique involves collecting a sample of convenient elements, the selection of which is left to the researcher. Its main advantages are the fact that this is the least expensive, less time-consuming and most convenient sampling technique.

The survey was divided into four sections: socio-demographic characteristics; transportation habits; travel satisfaction and intention to use DRT. Each of the sections is explored below.

3.3.1. Socio-demographic characteristics

The first part of the survey aimed to collect data on socio-demographic characteristics of the participants (Jain et al., 2017), using variables such as age (Knierim & Schlüter, 2021), gender (Pani et al., 2023), occupation (Pak et al., 2023) and location (Li et al., 2022). The age gaps were chosen according to other mobility studies carried by the Portuguese National Statistics Institute. Usually, the variable "age" alone doesn't show significant impacts on intention of use (Knierim & Schlüter, 2021), but shows interesting findings when correlated with variables such as occupation (Kersting et al., 2021) and number of habitants per area (M. Zhang et al., 2023). The variable "gender" was included since travel satisfaction levels are impacted by it in all travel segments, with the exception of the private car (Pani et al., 2023). The variable "dependents" was also included in this study, even though, to the present date and to the authors' knowledge, no other studies have considered it.

3.3.2. Transportation habits

The second section was meant to obtain information about the respondent's transportation habits. Similar to other studies that focus on the intention of use of DRT systems, it is important to assess ability to drive (Li et al., 2022) and private car ownership (Kersting et al., 2021).

Based on the focus groups, understand what the most commonly adopted options for people who don't drive or don't own a car also proved to be relevant. The frequency of public transport use (de Oña, 2021) and the most used public transport mode (Lancée et al., 2017) are also considered key determinants of travel satisfaction, and should therefore be included. The questions regarding the use of a monthly pass, and which was the most used transport line were complements suggested by the Carris company. Adding to that, and based on information obtained in the focus groups, the travel mode used to get to the train station or other public transport stop was also a concern for many of the participants, so it was decided to add that variable. The trip purpose, travel time and activities performed during the trip were also evaluated, since they also influence travel well-being (De Vos et al., 2013).

3.3.3. Travel satisfaction

The third part of the survey focused on travel satisfaction and travel affect. For the first question, that aimed to assess how satisfied respondents were with the current transport system, they were asked to answer, on a five Likert Scale (where 1 = totally unsatisfied and 5 = totally satisfied) how satisfied they were about the following characteristics: Connection with other city areas, frequency, punctuality, cleanness of the vehicles, comfort in getting on/off the vehicles, comfort at the stop, crowding in the vehicle, possibility to seat during the travel and ticket cost, as done by Rossi et al. (2023) and Zhao et al. (2024), among others. Originally proposed by Ettema et al. (2011), the Satisfaction with Travel Scale (STS) has been developed based on methods that measure affective subjective well-being such as the Swedish Core Affect Scale (SCAS) (Västfjäll & Gärling, 2007) and daily cognitive subjective well-being, measured by the Satisfaction With Life Scale (SWLS) (Pavot & Diener, 1993). In the STS the items measuring affective well-being during travel are based on the Swedish Core Affect Scale (SCAS) (Ettema et al., 2011; Västfjäll & Gärling, 2007) and the core affect model by Russell (1980, 2003; De Vos et al., 2015). Later validated by De Vos et al. (2015), STS was chosen to integrate this survey since it is the most common scale among similar works (Glasgow et al., 2018; Guan et al., 2023; Olsson et al., 2012; Singleton, 2019; Sukhov et al., 2021) and it is very user friendly and simple to understand when translated to portuguese.

This scale is divided into three dimensions - activation, valence and cognitive evaluation (Ettema et al., 2011). For the first two dimensions, respondents must answer, in a seven point scale, to what extent they felt a set of adjective pairs, while the cognitive dimension is measured through a set of three statements regarding the trip. It was decided to leave the cognitive dimension out since travel satisfaction was already being evaluated with the previous quotes, that allowed to gain more insight about the characteristics that travellers were, or not, satisfied with (Zeid, 2009).

3.3.4. Intention to use DRT

Section four sought to evaluate the intention to use DRT systems, giving a brief explanation of how these systems operate. To assess intention of use, a set of quotes was adapted from the literature (Pak et al., 2023) and respondents had to say to what extent they agreed to it, on a five Likert Scale (where 1 = totally disagree and 5 = totally agree). The same method was applied in order to understand which characteristics were important for participants to find in DRT systems. The quotes were based on characteristics found in the literature (Berrada & Poulhès, 2021; Schasché et al., 2023), on services that already exist in the Intermunicipal Communities that have these transport systems and on information arising from the focus groups, where participants shared features that would be present in an ideal DRT system. Lastly, the respondents had to choose from a set of options what purposes would they use DRT systems for.

Table 3.1, shown below, presents the four sections that compose the survey and its main topics, as well as the academic foundations that support each of them. As can be observed, the literature review and the qualitative data collected were essential to design the survey.

Table 3.3.1 – Authors that sustain the questions of the survey

	Survey Questions	Authors
Socio-demographic characteristics	Age	Knierim & Schlüter, 2021
	Gender	Pani et al., 2023
	Occupation	Pak et al., 2023
	Distance to the PT stop	Ikeh & Yuen, 2022
	Area (location size)	Knierim & Schlüter, 2021
	Dependents	Martins, M. L. (2024), Kalakou, S. (2024)
	Driving license	Li et al., 2022
	Car availability	Kersting et al., 2021
Transportation habits	Frequency of PT use	Mouratidis et al., 2023
	Preferred travel mode	Lancée et al., 2017
	Distance to the PT stop	Ikeh & Yuen, 2022
	Travel mode until the PT stop	Focus Group
	Intention to use	De Vos et al., 2013
	Activities performed during the trip	De Vos et al., 2013
Travel Satisfaction	Travel satisfaction with PT	Rossi et al., 2023
	Satisfaction with Travel Scale (STS)	Proposed by Ettema et al., 2011 and validated by De Vos et al., 2015
Intention to use DRT	Intention to use DRT	Pak et al., 2023
	Desired DRT characteristics	Schasché et al., 2023 Berrada & Poulhès, 2021 Focus Group Intermunicipal Communities interviews and best practices
	Purpose of DRT use	Martins, M. L. (2024), Kalakou, S. (2024) Focus Group Interviews to the Intermunicipal Communities

3.4. Data collection and analysis

The online survey previously described in 3.3. was distributed using Microsoft Survey, mainly through online networks such as LinkedIn, Facebook, institutional e-mail and Whatsapp groups. Some of the answers were also collected in public transport stops, especially for people between the ages of 64 and 85, due to the complexity of getting to respondents of that age group via online.

The data collected from the survey was later analysed using SPSS 29.0.2 software. Using the Analyse menu, in particular, Descriptive Statistics and Compare Means and Proportions, namely One-Way ANOVA, Independent Samples T-test and the respective Nonparametric test – Kruskal-Wallis (when the population was less than 30 observations in each reply category). Concerning One-Way ANOVA, firstly it was run the Scheffe and then Dunnett's 3 test, to check for differences when equal variances were not assumed. Since no significant differences were found, it was used the Scheffe to test for differences between the groups. It was also used the

Bivariate Correlation (Pearson test) to analyse if variables were correlated. Furthermore, a linear regression was used aiming to test the possibility of defining a model in which the dependent variable was “intention to use” and operational characteristics were the independent variables. As the R^2 was too low, the model was only included as indicative, since its interpretation helps corroborate the previous analysis. Throughout the analysis and discussion of results, there was also a present concern in integrating the theoretical references with the results obtained.

4. Results

This chapter presents the survey sample and its statistical results. Then, the research hypothesis are presented and explained. Lastly, a linear regression model is presented, aiming to test "intention to use" as a dependent variable and "operational characteristics" as independent variables. Since the R^2 was too low, the model is only indicative.

4.1. Survey Statistics

The survey was conducted online using Microsoft forms, during the month of March 2024. The data set was composed of 375 observations from Portuguese citizens.

4.1.1. Socio-demographic characteristics

There was a predominance of female respondents (59.7%) over male (39.5%) and a minority of 0.8% that preferred not to specify their gender. The majority of the respondents were comprised between the ages of 6 and 24 years old (38%), followed by the age group of 25 to 44 years old (30%); 23% were between 45 and 64 years old and 9% were between 65 and 84 years old. The propensity of younger ages to participate to online surveys and their increased familiarity justify the greater outreach to this group. Regarding occupation, most of the inquiries were active workers, where 44.5% were employees and 12.3% were self-employed and students represented 31.5% of the sample. Only 2.9% were unemployed and 8.8% were retired.

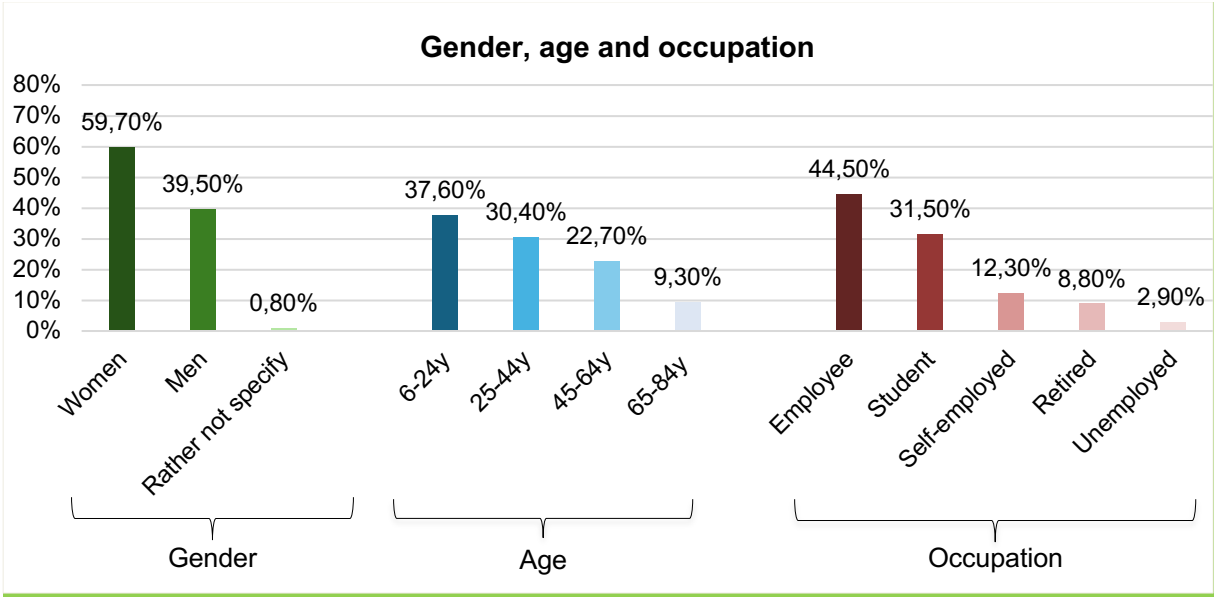


Figure 4.1 – Passengers' socio-demographic characteristics: gender, age and occupation

A significant part of the respondents reported living in urban areas (41%) and city centers (28.3%). Curiously, the percentage of people residing in suburban areas (14.4%) was lower

than the percentage of people living in rural areas (16.8%). However, more than half of the respondents lived more than 1km away from the nearest public transport stop (56.3%).

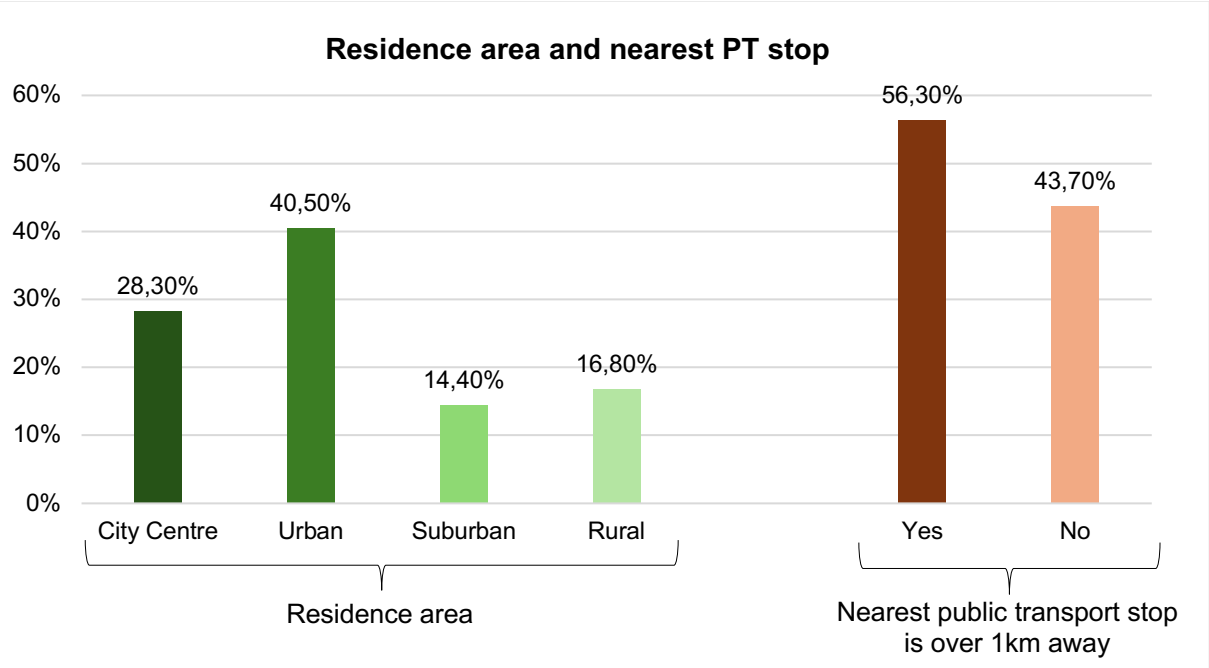


Figure 4.2 – Residence area and distance to the nearest public transport stop

Only 12.3% of the respondents had people who were depending on them regarding mobility, of which 3.7% was the percentage for both children between 6 and 12 years old and elders, followed by 2.1% for children younger than 6 years old. Only 0.3% had a disabled person as a dependent.

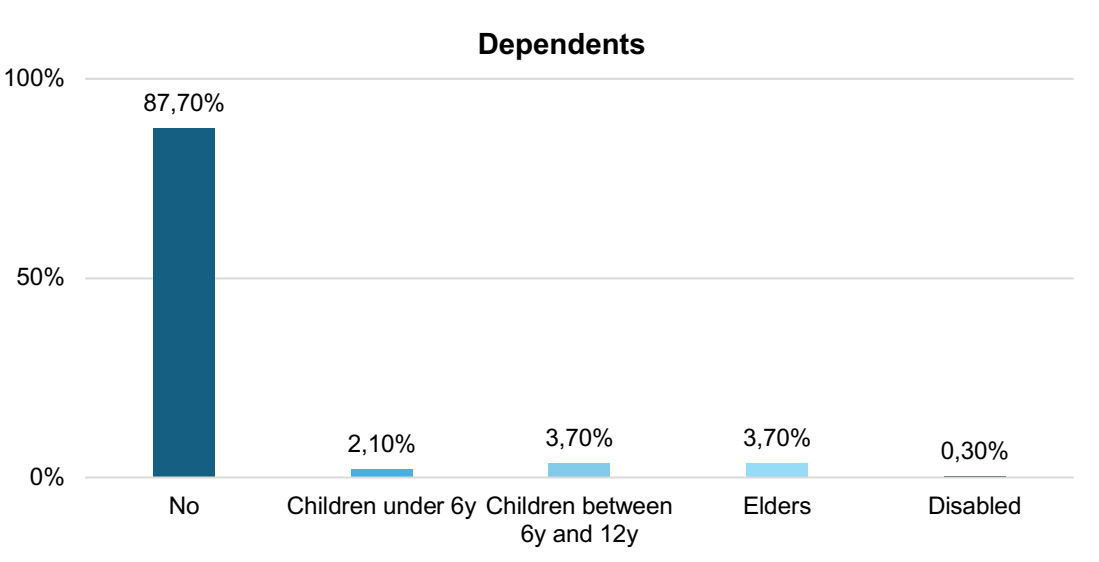


Figure 4.3 – Responsible for ensuring less mobile peoples' mobility and type of dependents

4.1.2. Transportation habits

When it comes to private vehicle use, 88% of the respondents had a driving license and 60% of them owned a car. Only 16% had a shared vehicle and 12% didn't have any vehicle, despite having a driving license.

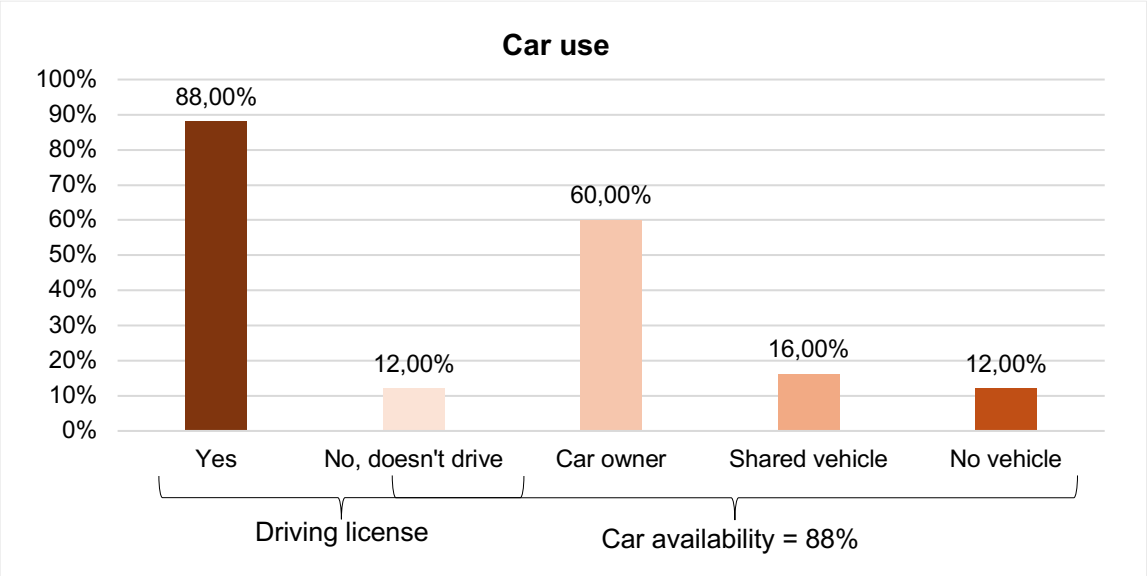


Figure 4.4 – Possession of driving license and car availability

Regarding public transport use, the majority of the respondents did not possess a monthly transportation card (61.1%) and near half of them (46.1%) reported to use public transport only once a month or less. Weekly public transport users represented a total of 46.4% of the sample, with more people using it on a daily basis (40,8%) rather than occasionally (13,1%).

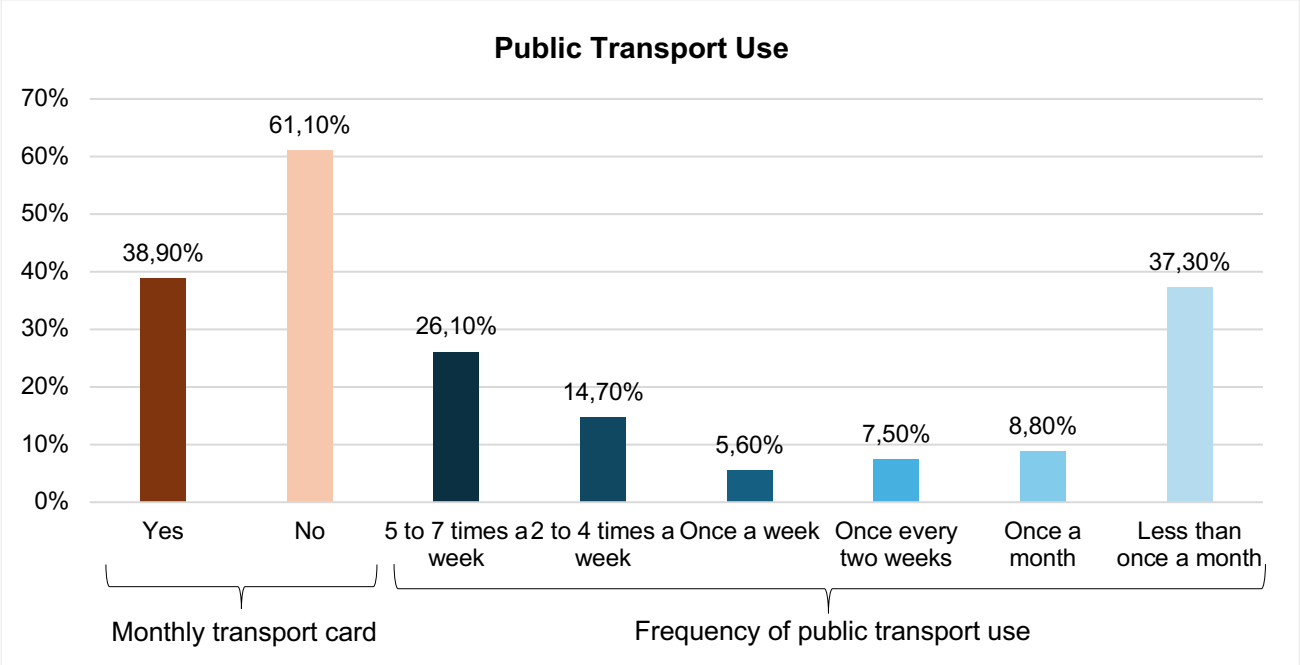


Figure 4.5 – Possession of a monthly transportation card and frequency of public transport use

The public transport modes that scored the highest percentages of respondents indicating them as being the ones they use the most are the bus (57.9%) and the metro (51.7%), followed by the train (37.3 %). Both bike or e-scooter and boat had a very low representation with percentages of 6.7% and 0.8%, respectively.

Even though metro was the second most used transport, it is interesting to note that it is actually the most popular between respondents, with 40% of the respondents considering it as

their preferred transport mode, followed by the train (31.2%) and lastly, by the bus (20.8%). However, exactly 6.7% of the respondents stated that they preferred to ride the bike or use an e-scooter, corresponding to the exact same percentage of respondents who answered it was their most used transport mode, suggesting it is used by choice. Only 1.3% of the respondents considered the boat their preferred transport mode, higher than the percentage of people who use it as their primary means of transport.

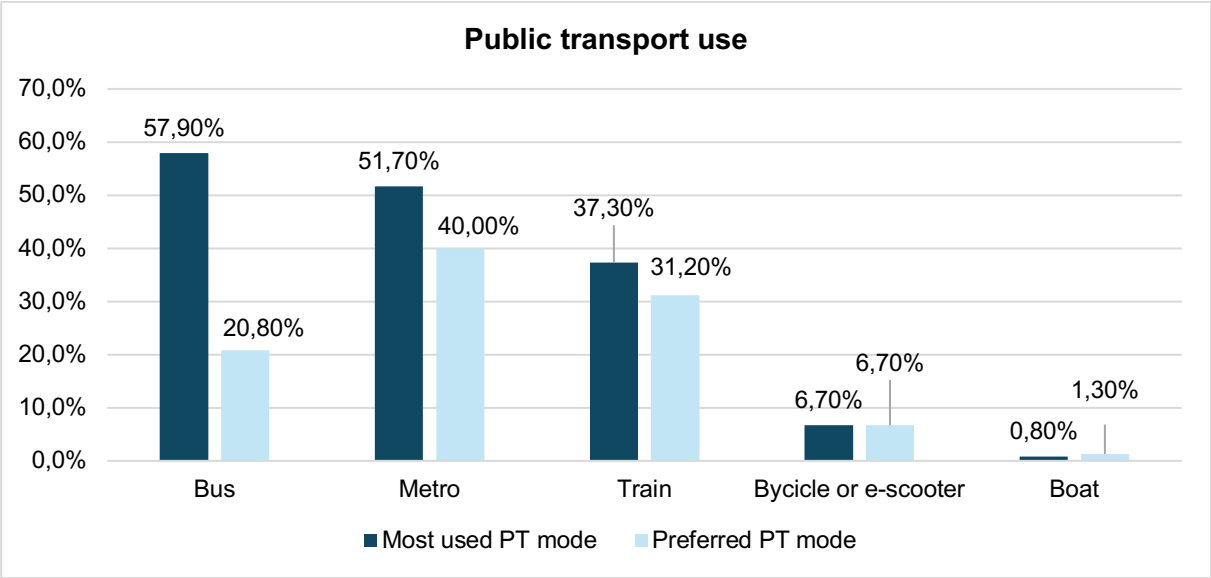


Figure 4. 6 - Most used and preferred public transport mode

Most people walk until their main public transport stop (69.9%), but many go by car, either as the driver (28%) or as a car passenger (17.6%). Bus (7.5%) is also a common way to arrive while metro (2.4%) and driving a motorcycle (1.1%) is less used as an intermediate mean of transport. Only a residual amount of people uses the train (0.8%) to get to their public transport stop and no one uses the boat.

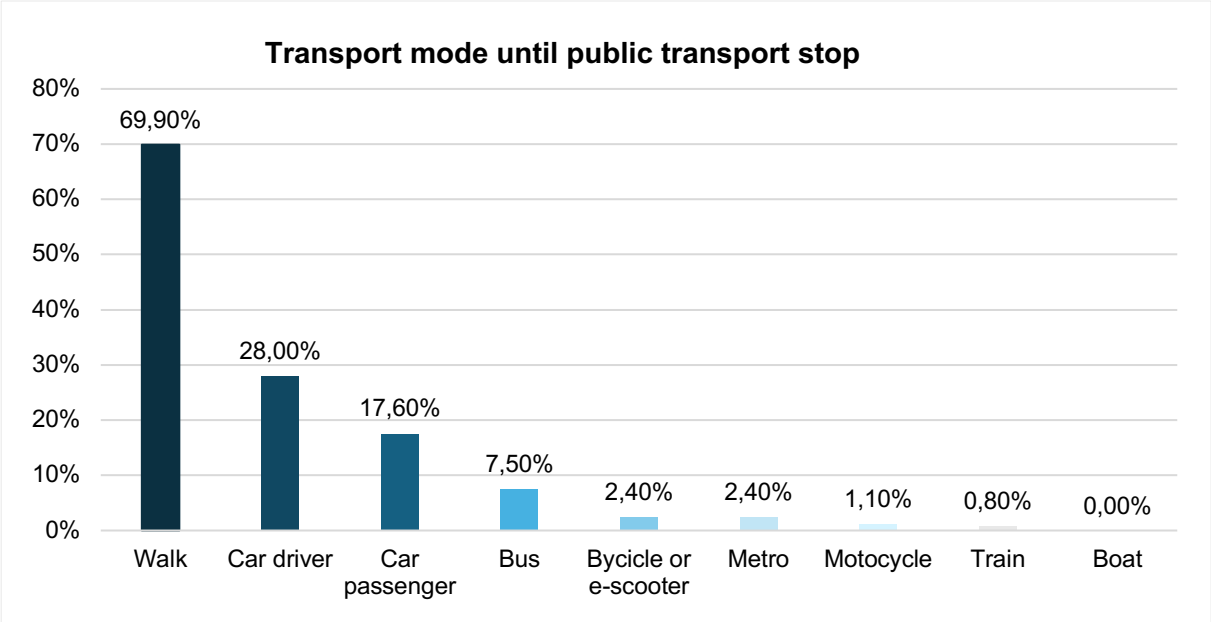


Figure 4. 7 – Transport mode used to get to the nearest public transport stop

The most common purpose people use public transport for is to leisure activities (35.5%) and social events (33.9%). Going to work and going to school or university was also a popular answer (28.7% and 27.7%, respectively), along with long travels (28.3%). To attend cultural events (14.7%) or to fulfill basic necessities such as groceries shopping, going to the hospital or to the bank and other services are the least used (14.1%).

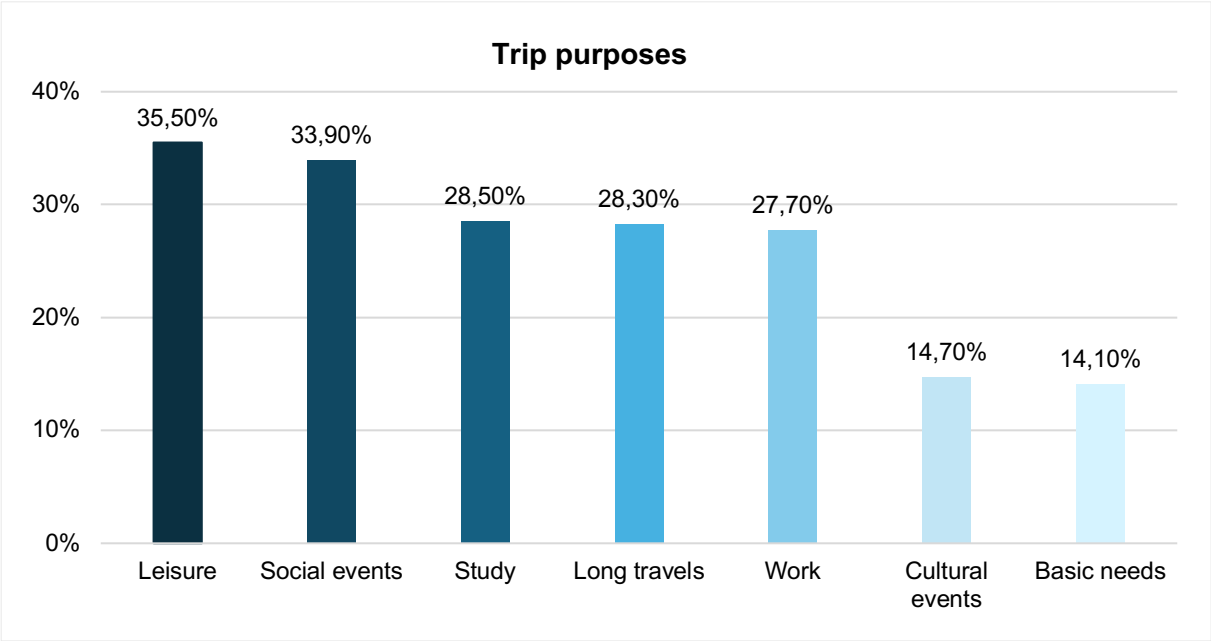


Figure 4.8 – Purposes for which people take public transport trips

The time spent on public transport is not considered a waste by 61.3% of the inquiries and 68.5% uses that time to do other activities such as calling family and friends, study, read and others.

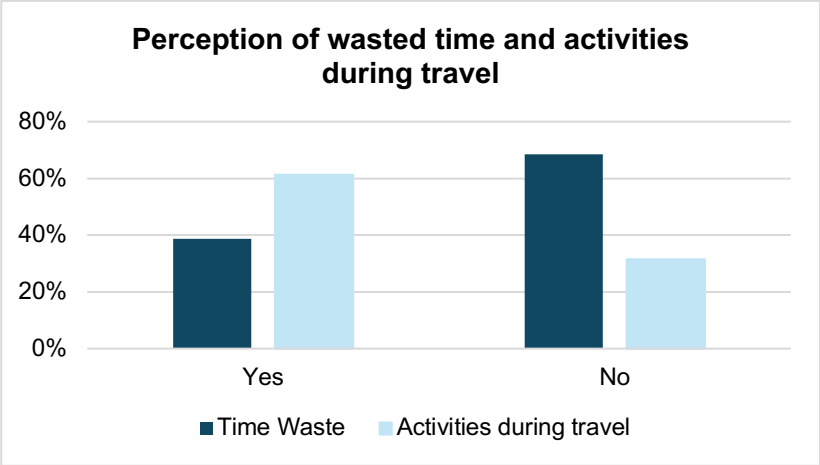


Figure 4.9 – Perception of wasted time and activities performed during travel

4.1.3. Travel satisfaction

Overall, the levels of satisfaction with the current public transport features evaluated were rather high. The highest levels of satisfaction are observed in connectivity to other transport

modes and connectivity to other areas, along with accessibility, with over 60% of the respondents being “satisfied” or “totally satisfied” with these aspects. The ability to find a seat and the cleanliness levels also reported fairly good levels of satisfaction, with around 50% of the respondents being “satisfied” or “totally satisfied” with it. Comfort shows a wider range in the responses, but there is still significantly more respondents showing general satisfaction towards it than dissatisfaction. On the other hand, respondents show the higher levels of dissatisfaction regarding the lotation of the vehicles, which is one of the aspects that can be overcome with DRT systems, along with punctuality, price and frequency with 30% of the respondents falling into the “dissatisfied” and “completely dissatisfied” categories.

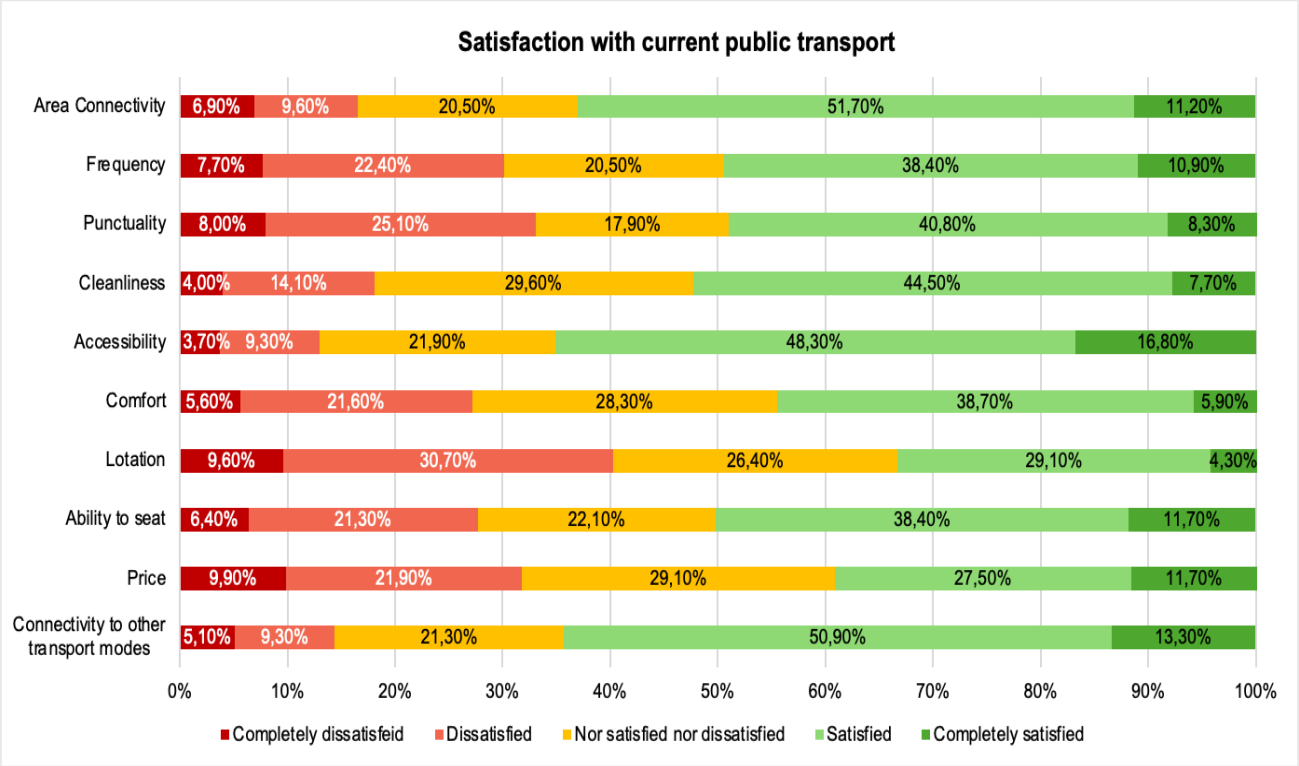


Figure 4.10 – Satisfaction with current public transport

The satisfaction with travel scale has been evaluated in several aspects, and the respondents were asked to indicate their feelings, positively or negatively. As observed the majority of the respondents have positive or neutral feelings. The highlight is in positive terms for “travel did work out”, with less than 15% reporting levels of dissatisfaction. However, it is important to stress that around 40% of the respondents felt more “hurried” than relaxed in their trip. Over 30% reported being more “tired” than “alert” and more “stressed” than “calm”. Little under 30% felt more “bored” than “enthusiastic”.

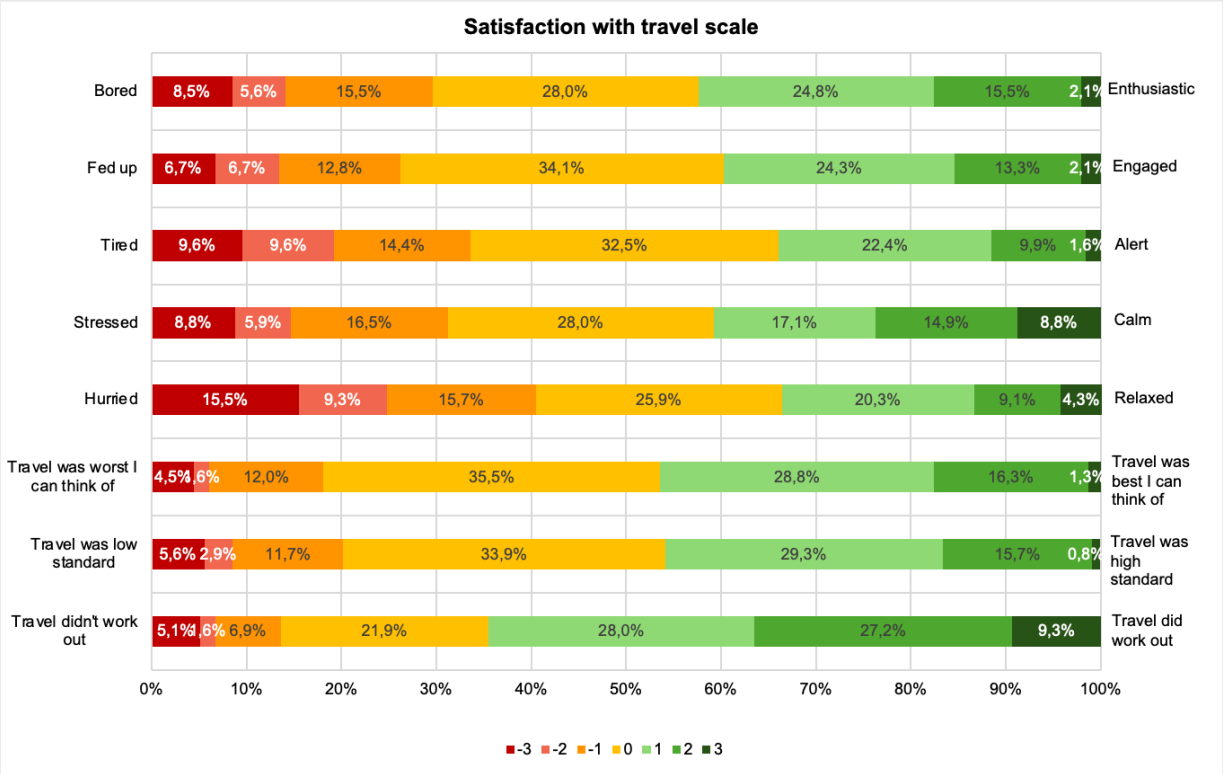


Figure 4.11 – Satisfaction with travel scale

4.1.4. Intention to use DRT

Over 60% of the respondents agreed or totally agreed with all of the statements presented in Figure 4.12 , suggesting that they perceive positively the benefits that the use of DRT systems can provide. Almost 70% of the respondents stated they would use a DRT system and less than 15% showed no intention of using it.

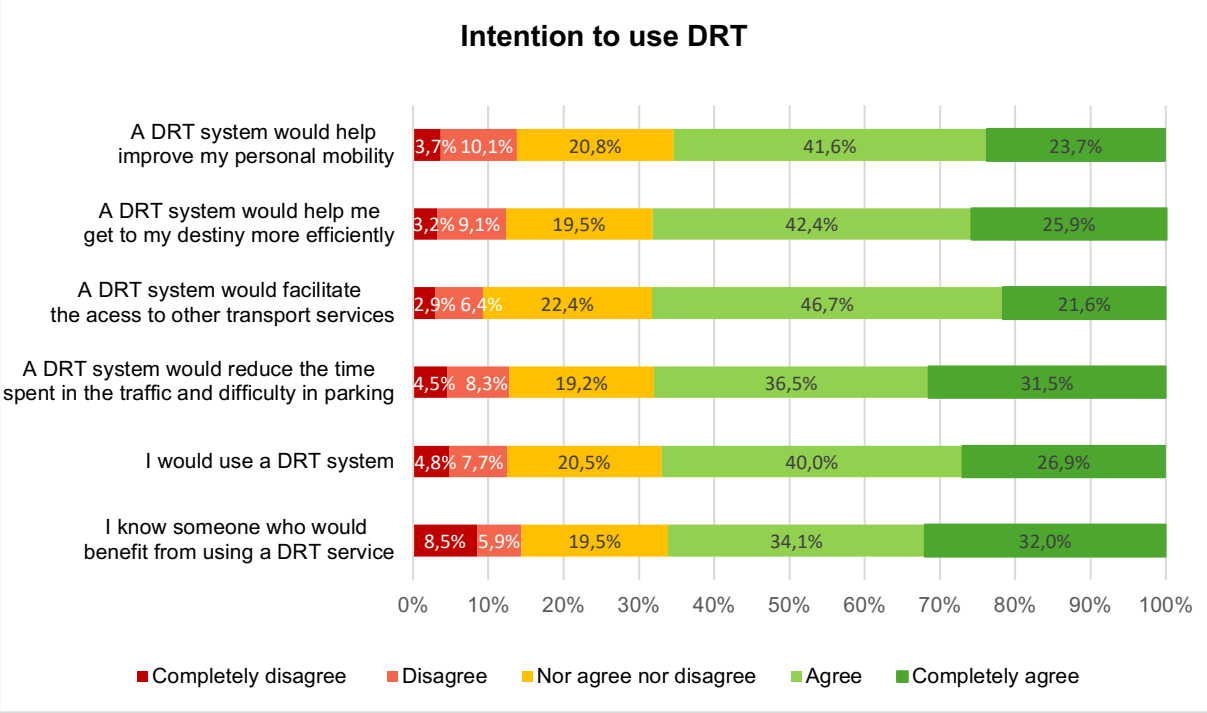


Figure 4.12 – Intention to use DRT systems

When people were asked about what characteristics would make them use a DRT system, two of them stood out. Improving their quality of life (86,9% agree or completely agree) and reducing their travel time (86,4% agree or completely agree) were the most important ones among respondents and providing more comfort was also a relevant feature (82,4% agree or completely agree). Surprisingly, having fixed destinations (82,4% agree or completely agree) that allowed people to get to essential services, such as hospitals, banks, schools and others, proved to be slightly more attractive than having fully flexible routes (80,5% agree or completely agree), where both pick-up and drop-off points were chosen by users. The possibility of the service being available 24 hours a day was a much more desired feature (80,8% agree or completely agree) when compared to the system having pre-defined schedules to operate, where almost 20% of the respondents said they wouldn't use a DRT system with this characteristic. Curiously, having a door-to-door service or the pick-up being done in an already existing public transport stop didn't seem to impact very much the intention to use such a service. Even so, there was a preference for a door-to-door service (69,6% agree or completely agree) over a PT stop (68,4% agree or completely agree).

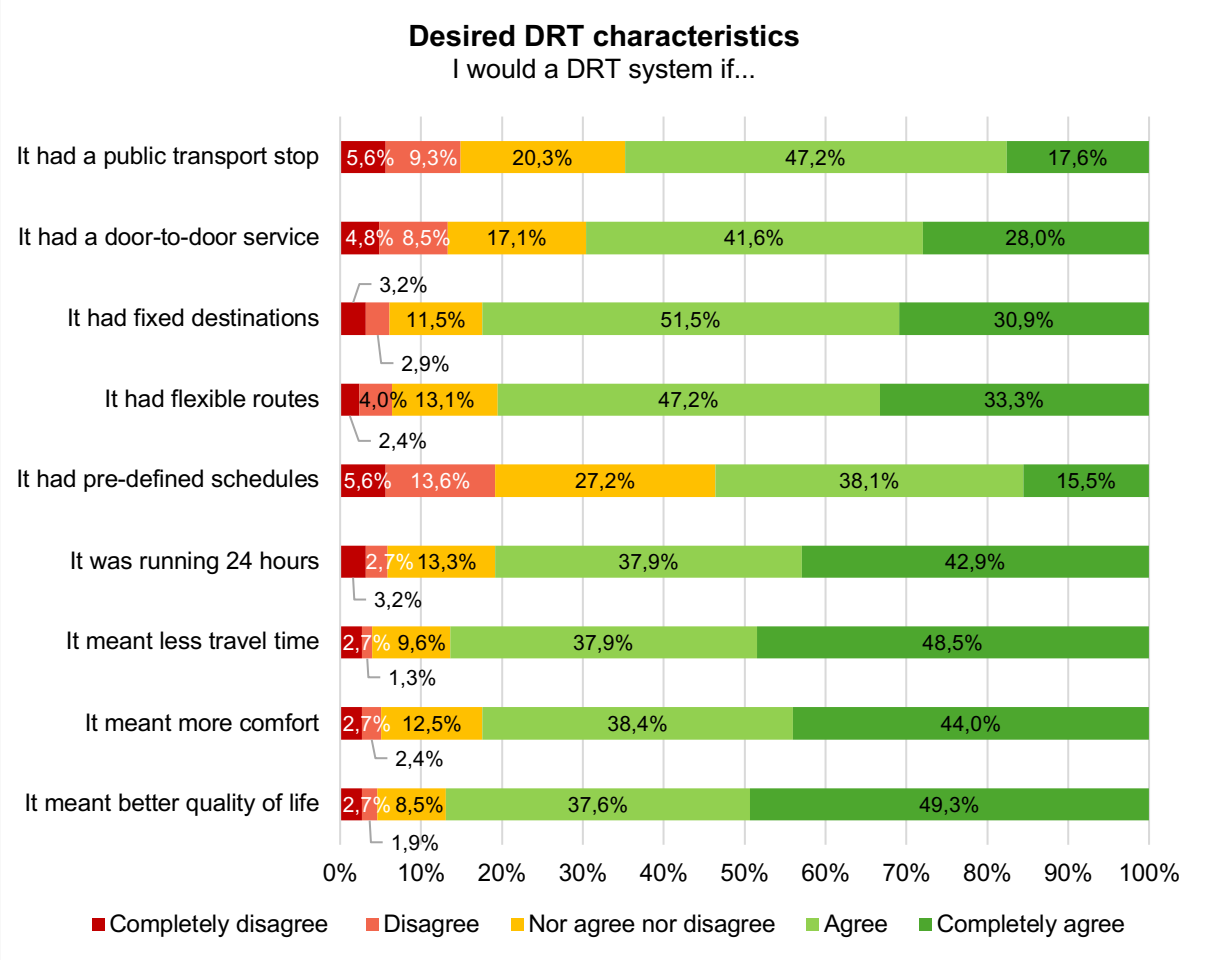


Figure 4.13 – Desired DRT characteristics

Regarding purpose, respondents showed more interest in using DRT systems to go to social events occurring at night (79.2%), services (77.1%) and very crowded events such as festivals or football games (76%). Furthermore, these systems also seemed quite appealing to go to cultural and leisure activities (67.5% and 65.9 %, respectively) or doing activities with dependents (65%). Interestingly, the data shows that more people were interested in using DRT to go to work (64.4%) rather than to school or university (57%). However, this might be due to the fact that there were more active workers participating in the survey than students.

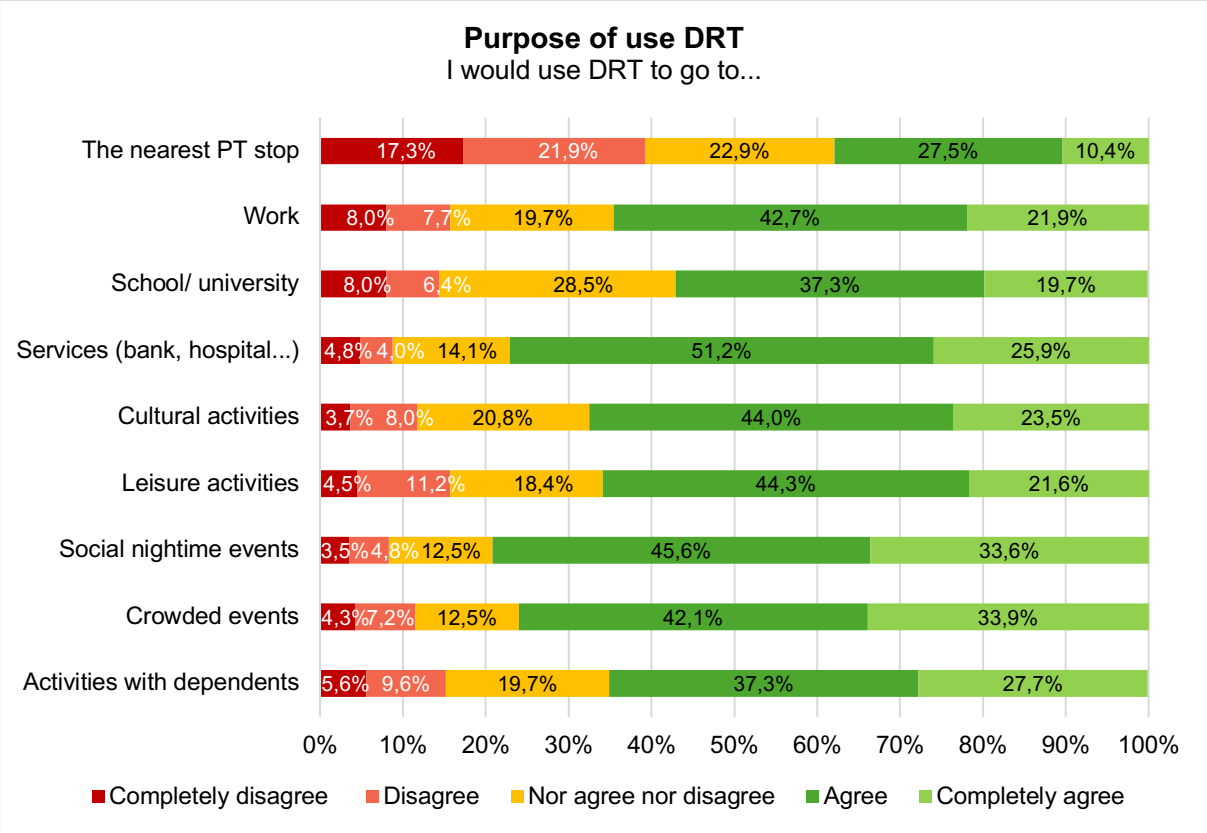


Figure 4.14 – Purpose of use DRT

4.2. Hypothesis testing

In order to assess if and which demographic attributes and mobility characteristics could affect the intention to use DRT systems and the perception of operational DRT characteristics, a series of mean comparisons tests were conducted, mainly One-Way ANOVA, T-test and Kruskal-Wallis. The decision rule used consists of rejecting the null hypothesis for p-values less than 5%. The hypothesis tested have been chosen in order to respond to the main questions, there so, personal and mobility characteristics were tested.

4.2.1. Intention to use DRT

H1: There is a significant difference in the intention to use between individuals with different sociodemographic characteristics.

H2: There is a significant difference in the intention to use between individuals with different transportation habits.

As we can see in Table 4.1.1., regarding *sociodemographic characteristics*, the variables *"area"* and *"distance to the nearest public transport stop"* proved to be significant on influencing intention to use DRT systems. Concerning *"area",* people who live in rural settlements are more likely to use such systems (p=.014) in opposition to people who live in non-rural areas (city centre, urban and suburban areas). *"Distance to the nearest PT stop"* is another variable that can influence intention to use (p=.037), with people who live further than 1km away of their nearest public transport stop showing a higher intention to use DRT systems than people living closer to one. Considering *transportation habits*, only *"regular train users"* appear to be more likely to use DRT systems than people who travel with other travel modes.

In conclusion, both H1 and H2 are partly sustained.

Table 4.1.1 - Mean comparison analysis for intention to use DRT

Intention to use			
Sociodemographic characteristic	**P-value**	**Transportation habits**	**P-value**
Age	.519	Drivers' license	.443
Gender	.110	Car availability	.683
Occupation	.695	Monthly transportation card	.979
Area	**.014**	Frequency of use PT	.495
Distance to the nearest PT stop	**.037**	Metro	.888
Dependents	.842	Bus	.389
		Train	**.081**

4.2.2. Operational characteristics of DRT systems

H3: There is a significant difference in the perception of operational characteristics between individuals with different sociodemographic characteristics.

H4: There is a significant difference in the perception of operational characteristics between individuals with different transportation habits.

The same analysis were done to test if operational characteristics were perceived differently depending on sociodemographic characteristics and transportation habits.

Considering *sociodemographic characteristics*, having a “door to door service” is more or less important depending on *“gender”* (p= .034) - women tend to value this feature more than men. The same happens when looking at the characteristic “fixed destinations”, which is perceived differently depending on *“gender”* (p=.033) – again, with women considering this feature of greater importance than men. Furthermore, the service providing a system with “flexible routes” was considered valuable for individuals of *”age”* comprised, between 6 and 44 years old (p=<.001) and people with a different *“occupation”* (p=.029), suggesting that potential users may vary depending on their socioeconomic status and occupation (p=.029). The same was true for the following features: “running 24 hours” (p=<.001), meaning “less travel time” (p=<.033), “more comfort” (p=<.048), and “better quality of life” (p=<.016).

As for “pre-defined schedules”, there were statistical differences between people who lived, or not, further than 1km away from their *“nearest public transport stop”* (p=.048), meaning that people who live more than 1km away value this characteristic more. The variables *“area”* and *“dependents”* were the only variables that didn’t present any statistical differences, suggesting that potential users can be based both in rural and non-rural areas and not necessarily have dependents in order to be likely to use such services. Having a pre-defined “public transport stop” was the only operational characteristic that presented no differences, as shown in Table 4.2.1..

As for *transportation habits*, having a “public transport stop” only proved to be relevant to *“bus”* users (p=.011). People whose primary transport mode is the “*metro*” considered having a “door to door” service an important feature (p=.055), rather than those who mainly travel by other travel modes. In regard to having “fixed-destinations”, having a *“driving license”* (p=.037) impacts the perception of this feature and people who do not own a driving license consider having “fixed destinations” (such as hospitals, banks and other services) an important characteristic (p=.037). “Flexible routes” and “pre-defined schedules”, on the other hand, were considered a relevant characteristic for *“bus”* users (p=.085 and p=.034 respectively), contrarily to other travel modes. The service “running 24 hours”, meaning “less travel time”, “more comfort” and overall “better quality of life” was impacted by the variables *“driving license”* (p=<.022), *“car availability”* (p=<.001) and *“frequency”* (p=<.027) of public transport use, meaning that, were these characteristics present in DRT systems, people would consider this to be a valuable system. People who own a monthly transport card (p=<.028) also proved that, were the service to improve “travel time” and “better quality of life”, would they consider it better. The same was found to *“metro”* users *(p=<.037),* adding to it the “comfort” that could be increased. *“Train”* users considered more important having “more comfort” (p=.025) and “better quality of life” (p=.018).

In conclusion, H3 is partly sustained and H4 is sustained.

Table 4.2.1. Mean comparison analysis for operational characteristics

Operational characteristics	Public Transport Stop	Door to door	Fixed Destinations	Flexible routes	Pre-defined schedules	Running 24h	Less travel time	More comfort	Better quality of life
Sociodemographic characteristics									
Age	.285	.408	.053	**<.001**	.193	**<.001**	**<.001**	**.005**	**<.001**
Gender	.245	**.034**	**.033**	.540	.998	.424	.122	.194	.310
Occupation	.759	.160	.306	**.029**	.346	**<.001**	**.033**	**.048**	**.016**
Area	.998	.205	.118	.150	.989	.915	.613	.807	.567
Distance to PT	.304	.197	.187	.197	**.048**	.911	.673	.626	.705
Dependents	.125	.953	.331	.518	.394	.679	.855	.657	.535
Transport Habits									
Driving license	.217	.377	**.037**	.136	.115	**.024**	**.022**	**.001**	**.001**
Car availability	.219	.697	.093	.215	.317	**.006**	**<.001**	**<.001**	**<.001**
Frequency	.126	.672	.360	.093	.315	**.010**	**.007**	.240	**.029**
Monthly Transport card	.579	.499	.805	.139	.673	.090	**.006**	.675	**.028**
Metro	.556	**.055**	.591	.896	.130	.422	**.037**	**.029**	**.019**
Bus	**.011**	.471	.403	**.085**	**.034**	.383	.467	.616	.740
Train	.117	.279	.683	.328	.231	.199	.166	**.025**	**.018**

4.3. Factors influencing intention to use

In order to better interpret and corroborate the results shown above, it was developed the model shown below, using a Linear Regression analysis.

$$Intention\ to\ use = \beta_0 + \beta_{PT\ stop} + \beta_{Door-to-door} + \beta_{Fixed\ destinations} + \beta_{Flexible\ routes} + \beta_{Pre-defined\ schedules} + \beta_{Running\ 24h} + \beta_{Less\ travel\ time} + \beta_{More\ comfort} + \beta_{Better\ quality\ of\ life}$$

Due to the very high $\beta_{Running\ 24h}$, it was also done a model without that operational characteristic, but no significant differences were shown. Therefore, it was decided to continue with the present model.

Despite the R^2 of the model being of low value, and the analysis having to be seen from a qualitative point of view, it is interesting to show how the analysed variables impact intention to use.

As we can see in the Figure 16, all operational characteristics positively affect intention to use, except for having pre-defined schedules and less travel time, which is in line with previous results, since future DRT users will be looking for a service that doesn't have the same characteristics as a traditional public transport, including fixed schedules and longer routes. When using the model in a qualitative way, without using it to predic the potentital associated with intention to use, it is important to understand if the impact tendency is aligned with the literature and the previous results, underlining the conclusions reached throughout the analysis.

It is also worth mentioning the importance of the service running 24 hours, due to its β. Even though it is a characteristics that people might not use, it is a determinant factor and has a very significant impact, meaning that potentially people would use DRT services at any time, without the pre-defined and tight schedules of the conventional transportation services.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.684	.168		4.067	<.001
	IT HAD A PUBLIC TRANSPORT STOP	.146	.038	.217	3.819	<.001
	IT HAD A DOOR TO DOOR SERVICE	.096	.038	.148	2.510	.013
	IT HAD FIXED ROUTES	.127	.060	.163	2.110	.036
	IT HAD FLEXIBLE ROUTES	.080	.058	.104	1.377	.169
	IT HAD PRE-DEFINED SCHEDULES	-.029	.035	-.045	-.830	.407
	IT WAS RUNNING 24 HOURS	4.120E-5	.051	.000	.001	.999
	IT MEANT LESS TRAVEL TIME	-.096	.073	-.121	-1.311	.191
	IT MEANT MORE COMFORT	.060	.071	.079	.850	.396
	IT MEANT BETTER QUALITY OF LIFE	.091	.080	.116	1.142	.254

a. Dependent Variable: Intentiontouse

Figure 15 – Coefficients of the model "Intention to Use"

5. Discussion.

In this section, the main findings reached with this research are discussed and compared with the existent literature.

5.1. Intention to use

Based on the aforementioned analysis, it can be concluded that only the sociodemographic variables "distance to the nearest public transport stop" and "area of residence" exhibited significant differences when examining the intention to use DRT in Portugal, thus addressing the first part of the initial research question “What socio-demographic characteristics and transportation habits affect intention of use?”.

The variable “*age*” is recurrently found to be a predictor factor of DRT use. However, various authors have reached different conclusions regarding whether younger or older people are more inclined to become DRT users. Studies conducted by Vij et al., (2020), Xing et al., (2022) and Zhao et al., (2024), suggest that younger individuals are more likely to use DRT compared to their older counterparts. Conversely, Brake et al., (2004), Thao et al., (2023) and C. Wang et al., (2015b) indicate that the intention to use DRT increases with age and lifecycle stage and older individuals are more commonly found among DRT users. Kersting et al. (2021), further explored the impact of age on DRT usage through a pilot study of the EcoBus system in Germany, finding that the intended use of the DRT was significantly influenced by the size of the locality and the number of its inhabitants. In larger communities with populations exceeding one thousand inhabitants, the likelihood of using DRT diminished with age, whereas in smaller villages with populations below one thousand, older residents showed a higher inclination towards using DRT. This study, however, did not establish a significant correlation between *“age”* and *“area”,* and the variable *"age"* alone did not prove to be a significant determinant of the intention to use DRT systems, as previously noted by (Knierim & Schlüter, 2021).

The findings of this research indicate that *“distance to the nearest public transport stop”* significantly influence the intention to use DRT systems. Specifically, individuals residing more than one kilometer from their nearest public transport stop are more likely to adopt DRT systems compared to those living closer, a conclusion consistent with existing literature (Anspacher et al., n.d.; Thao et al., 2023; Zhao et al., 2024). According to Truden et al., (2022), walking to the nearest public transport stop may not be feasible for all users, highlighting the need for additional micro-transit stops to facilitate access to main public transportation and eliminate the initial barrier that deters potential users.

The typology of residence *"area"* also demonstrated significance within the Portuguese context. Contrary to the conclusions drawn from the focus groups, people living in rural areas exhibited higher likelihood of adopting DRT systems compared to those living in non-rural areas, as stated in the literature by Morsche et al., (2019) and C. Wang et al., (2015b).

The remaining sociodemographic characteristics, namely *"gender", "occupation"* and *"dependents"* were not significant to determine the intention to use DRT systems.

Curiously, transportation habits didn't prove to be significant to influence intention to use either, answering the second research question. As opposed to several studies in the field (Kersting et al., 2021; Morsche et al., 2019; Thao et al., 2023; Xing et al., 2022), the finding of this research show that having a *"driving license"* or having access to a car *("car availability")* were not determinant factors of intention to use DRT. However, they were consistent with the results of Y. Zhang et al., (2022) and Zhao et al., (2024), that also found that being a "car user", both as a passenger or a driver, and having access to a vehicle was insignificant to predict intention to use DRT. Unexpectedly, individuals who perceive public transport as a waste of time didn't have a higher intention to use DRT systems, as was demonstrated in previous studies (Xing et al., 2022).

Concerning the use of public transport, having a *"monthly transportation card"* doesn't appear to impact intention to use DRT systems, in contrast with the findings of Thao et al., (2023).The frequency of public transport use was not significant either, differing from the conclusions reached by Schasché et al., (2023).

5.2. Operational characteristics

Both sociodemographic characteristics and transportation habits proved to be important factors to take into account when assessing what characteristics are more valuable to possible DRT users. *"Age", "gender", "occupation"*, and *"distance to the nearest public transport stop"* were the sociodemographic characteristics that presented significant differences, along with all the variables that constitute transport habits: *"driving license", "car availability", "frequency" of public transport use, "monthly transportation card"* and the most used public transport mode – *"metro", "bus" and "train",* providing the answer for the third and fourth research questions.

Throughout the literature analysed in the course of this thesis, few, if any, were the articles that focused on the operational characteristics of DRT systems. As such, this work provides innovative aspects regarding the functioning and adoption of such systems, that must be taken into consideration when planning for Demand-Responsive Transportation.

6. Conclusion

This dissertation aims to contribute to the current literature on Demand-Responsive Transportation by studying intention to use and operational characteristics of such systems in Portugal. It is, to the authors knowledge and date, the first work to study what operational characteristics are more relevant to potential users and how related they are to their intention to use the service in the Portuguese context.

Throughout the literature analysed, papers who studied intention to use DRT focused mainly on local DRT pilot projects. This study, on the contrary, focused on people residing in Portugal, of all ages, occupation and residence areas. As such, it was possible to conclude that, regarding area of residence, for instance, people living in rural settlements were more keen to become DRT users. This finding is in line with the current literature, since most of the papers mentioned in the course of this work were studying the impact of DRT systems in rural areas. In addition, it was also found that, as according literature, individuals who live further than one kilometer away from their nearest public transport stop, are more likely to use DRT systems. Opposing to what was expected, neither age nor gender revealed to be important factors regarding intention to use, together with occupation. This work also aimed to discover if the variable *"dependents"* was a key variable for determining intention to use, but no correlation was found between the two variables. As for transportation habits, it was found that people who use the train as their main transport mode are more ikely to adopt DRT systems in the future. In conclusion, the first two hypothesis were only partialy sustained.

The most innovative part of this dissertation focuses on what operational characteristics seem to be more important and for what type of users. It was found that the most relevant characteristics was the service to be running for 24 hours; providing a trip that represented less travel time compared to other transport modes; providing more comfort during the trip; and representing an improvement on overall quality of life. As for the remaining operational characteristics, only bus users showed a preference for having a public transport stop, while metro users preferred a door-to-door service. People who don't have a driving license would like a DRT service to have fixed destinations while bus users preferred a service with flexible routes, but pre-defined schedules.

A linear regression model was also tested to look for explanatory variables of "intention to use". However, as its R^2 was too low, it is only indicative of what was previously stated.

Results of this study reveal the urgency to rethink and redesign travel modes so as to provide transportation systems that are more attractive to users. Taking into account the fast paced growth of Portuguese cities, one of the most pressing issues nowadays is urban mobility. DRT systems present a viable and sustainable solution that integrates smart and sustainable mobility. It is an innovative approach that makes transportation services more efficient and accessible for all (Waqar et al., 2023), since they use use advanced technology to create efficient route planning, real time tracking and scheduling, so that the system becomes as responsive as possible to the passengers.

Many argue about the sustainability of DRT, since it can be seen as a setback and even an incentive to the use of private vehicles. However, it is worth considering that the available fleet would only run when there is an actual demand for it and it will never be used under its capacity. Besides that, the vehicles that typically constitute these types of fleets are always smaller than regular buses, thus having a lower impact on the environment. The same goes when comparing the use of a vehicle used to its full capacity or five cars with a maximum of two passengers each. One particularly important characteristic of these systems is that they take advantage of the already existing infrastructures (vehicles, stops, etc), and, many times, improve them by providing users with last mile slow-mobility solutions such as walking or biking (Porru et al., 2020) and, in other cases, trolley-buses and various multi-modal options (Ivashova et al., 2022). Since DRT solely operates when there is an actual demand, DRT systems help reducing the use of private vehicles and underused buses, contributing to the reduction of emissions and pollutant gases (Hussain et al., 2023) and improve overall public health (Eckhardt et al., 2020).

7. Limitations and future work

In the course of this dissertation, some limitations were identified and provided valuable insights on how to proceed in the design of similar research in the future. Both the limitations and suggestions for future research are discussed in this chapter.

The main limitation of this research is the sampling technique, in this case non-probabilistic by convenience, which in turn does not allow for a significant illustration of the population under study, due to the impossibility of generalizing results. Additionally, the sample used presented a slight imbalance respecting the age groups, with a greater number of young respondents participating in this study, which represents a possibility of greater bias in the results. In this sense, a more heterogeneous sample is recommended for future research.

Although the findings of this work highlight some factors that have an impact on the intention to use Demand-responsive systems and, especially, provide relevant information regarding the operational characteristics that possible users find more attractive, additional research is required to strengthen the knowledge of these topics. Furthermore, it would be important to carry out extra studies, with greater sample sizes and delimited areas, in order to provide a more robust and accurate analysis.

Considering the results obtained in this dissertation, sociodemographic characteristics don’t have a significant influence on intention to use Demand-Responsive Transport, apart from the residence area and distance to the nearest public transport stop. Residents of rural areas who must travel distances exceeding one kilometer report a higher intention to use DRT. Moreover, individuals whose primary mode of public transportation is the train demonstrate a greater propensity to use DRT compared to those who predominantly use bus or metro services. Future studies should also consider adding the socio-economic condition of the respondents, combining occupation and income. Considering the importance given to each of the suggested operational characteristics, both socioeconomic characteristics and transportation habits proved to be relevant in this research, so it is recommended that these continue to take part in future studies.

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Appendix

A.1. Questions of the interview to the municipality of Paredes de Coura

1. Como caracterizaria o sistema de transportes da região?
2. Existe intermodalidade de transportes? A rede de transportes é pensada de forma a otimizar os recursos e combinar vários meios de transporte e ligações?
3. Atualmente, que iniciativas existem ao nível da mobilidade?
4. Existem verbas da UE, nacionais, ou outras para gastar em mobilidade?
5. Existem planos futuros de investimento na área da mobilidade?
6. O que gostaria de ver melhorado nesta área?
7. Como descreveria as ligações entre o concelho? E, principalmente, entre o distrito?
8. Sente que iniciativas de mobilidade sustentáveis seriam bem recebidas, quer a nível das câmaras municipais, quer a nível dos cidadãos?

A.2. E-mail questionnaire

1. Como caracterizaria o sistema de transportes da região?
2. Existe intermodalidade de transportes? A rede de transportes é pensada de forma a otimizar os recursos e combinar vários meios de transporte e ligações?
3. Atualmente, que iniciativas existem ao nível da mobilidade?
4. Existem verbas da UE, nacionais, ou outras para gastar em mobilidade?
5. Existem planos futuros de investimento na área da mobilidade?
6. O que gostaria de ver melhorado nesta área?
7. Como descreveria as ligações entre centros urbanos? E, principalmente, entre capitais de distrito?
8. Sente que iniciativas de mobilidade sustentáveis seriam bem recebidas, quer a nível das câmaras municipais, quer a nível dos cidadãos?

A.3. Questions of the Focus Group

1. Indique a sua zona de residência.
2. Como descreve o transporte público atual da sua zona de residência?
3. Com que frequência utiliza transportes públicos?
4. Quais são, atualmente, os entraves que reconhece à utilização do transporte público?
5. Quão frequentemente opta por outro tipo de transporte que não o carro? Porquê?

6. Quais são os impactos que a falta de um sistema de transporte público adequado provoca no seu bem-estar e qualidade de vida?

7. Qual o impacto que a utilização do carro provoca no seu bem estar e qualidade de vida?

8. Quais são as suas principais necessidades de mobilidade? (Ex. Boa acessibilidade, flexibilidade de horários, flexibilidade de rotas, proximidade das paragens, duração da viagem, outros...)

9. Qual seria a probabilidade de utilizar um serviço público, de marcação prévia e possivelmente partilhado, que oferecesse um transporte porta-a-porta, dentro da sua área de residência? E para fora dessa área?

10. Quão satisfeito está com as suas opções de mobilidade?

A.4. Online Survey

Pergunta	*Resposta*	*PERGUNTA*	*RESPOSTA*
DADOS SOCIODEMOGRÁFICOS			
Por favor indique a sua idade.	6 a 24 anos		
	25 a 44 anos		
	45 a 64 anos		
	65 a 84 anos		
Por favor indique o seu género.	Feminino		
	Masculino		
	Prefiro não especificar		
Por favor indique a opção que melhor descreve a sua ocupação laboral.	Estudante		
	Desempregado		
	Trabalhador por conta de outrem		
	Trabalhador por conta própria		
	Reformado		
Vive a mais de 1km de uma estação de comboio ou metro?	Sim		
	Não		
Por favor indique o tipo de área onde reside.	Centro da cidade		
	Urbana		
	Sub-urbana		
	Rural		
É responsável pela mobilidade de outras pessoas?	Sim	**Por favor indique a opção que melhor descreve a/s pessoa/s por quem é responsável**.	Crianças com menos de 6 anos
			Crianças de 6 a 12 anos
			Crianças com mais de 12 anos
			Idosos
			Pessoas com deficiência
	Não		
HÁBITOS DE DESLOCAÇÃO			
É portador de carta de condução?	Sim		
	Não		
Tem um veículo automóvel ou motociclo à sua disposição sempre que necessário?	Sim, tenho um veículo próprio		
	Sim, tenho um veículo partilhado		
	Não, não disponho de qualquer veículo		
Tem passe mensal?	Sim		
	Não		

Qual a frequência com que utiliza transportes públicos?	5 a 7 vezes por semana		
	2 a 4 vezes por semana		
	1 vez por semana		
	1 vez em cada 2 semanas		
	1 vez por mês	**Qual a razão pela qual não utiliza transportes públicos regularmente?**	
	Menos de 1 vez por mês		
Por favor indique o modo de transporte público que mais utiliza para se deslocar.	Bicicleta ou trotinete		
	Metro		
	Autocarro		
	Comboio		
	Barco		
Por favor indique o seu modo de transporte público preferencial, isto é, aquele que mais gosta de utilizar.	Bicicleta ou trotinete		
	Metro		
	Autocarro		
	Comboio		
	Barco		
Como é que se desloca até ao seu modo de transporte principal?	A pé		
	De bicicleta ou trotinete		
	De carro como condutor		
	De carro como passageiro		
	De mota		
	De autocarro		
	De metro		
	De comboio		
	De barco		
Por favor indique qual a finalidade para a qual mais utiliza os transportes públicos.	Para ir trabalhar		
	Para ir para a escola/ universidade		
	Para atividades culturais		
	Para atividades sociais		
	Para lazer		
	Para necessidades básicas (compras, hospital, serviços)		

	Para fazer viagens longas/ longínquas
Considera o tempo que passa em transportes públicos "tempo desperdiçado"?	Sim
	Não
Aproveita o tempo que passa em transportes públicos para desempenhar outras tarefas, tais como estudar, trabalhar, ligar a amigos ou familiares, ver as notícias, ler, entre outros?	Sim
	Não

Indicadores de satisfação					
Pergunta	**Resposta**				
Por favor indique o quão satisfeito se encontra com cada uma das características abaixo mencionadas relativamente aos transportes públicos que utiliza.	Totalmente insatisfeito	Insatisfeito	Nem satisfeito nem insatisfeito	Satisfeito	Totalmente satisfeito
Conectividade com outras áreas					
Frequência					
Pontualidade					
Limpeza dos veículos					
Facilidade em entrar/ sair dos veículos					
Conforto na paragem					
Lotação de pessoas dentro do veículo					
Possibilidade desentar durante a viagem					
Preço do bilhete					
Conectividade com outros meios de transporte					

Pergunta	Resposta						
Numa escala de -3 a 3, por favor indique qual o sentimento que melhor caracteriza a sua experiência com transportes públicos	-3 (Farto)	-2	-1	0 (neutro)	1	2	3 (entusiasmado)
	-3(irritado)	-2	-1	0 (neutro)	1	2	3 (envolvido)
	-3 (cansado)	-2	-1	0 (neutro)	1	2	3 (alerta)
	-3 (ansioso)	-2	-1	0 (neutro)	1	2	3 (calmo)
	-3 (preocupado)	-2	-1	0 (neutro)	1	2	3 (confiante)
	-3 (apressado)	-2	-1	0 (neutro)	1	2	3 (relaxado)
Numa escala de -3 a 3, por favor indique qual o sentimento que melhor caracteriza a sua viagem em transportes públicos	-3 (o pior que posso imaginar)	-2	-1	0 (neutro)	1	2	3 (o melhor que posso imaginar)
	-3 (de baixo nível)	-2	-1	0 (neutro)	1	2	3 (de alto nível)
	-3 (não correm bem)	-2	-1	0 (neutro)	1	2	3 (correm bem)

Indicadores de intenção de uso e características de um sistema de transporte a pedido					
Por favor indique o nível de concordância relativo às seguintes afirmações:	Discordo totalmente	Discordo	Não concordo nem diiscordo	Concordo	Concordo totalmente
Um sistema de transporte a pedido ajudar-me-ia a melhorar a minha mobilidade pessoal.					
Um sistema de transporte a pedido ajudar-me-ia a chegar ao meu destino					

mais eficazmente.					
Um sistema de transporte a pedido iria facilitar o acesso a outros serviços de transporte.					
Um sistema de transporte a pedido iria reduzir o tempo despendido no trânsito e a dificuldade em estacionar.					
Eu usaria um sistema de transporte a pedido.					
Eu conheço alguém que beneficiaria de um sistema de transporte a pedido.					
Um sistema de transporte a pedido ajudar-me-ia a melhorar a minha mobilidade pessoal.					
Eu usaria um sistema de transporte a pedido para me deslocar...	Discordo totalmente	Discordo	Não concordo nem diiscordo	Concordo	Concordo totalmente
à paragem de transporte público mais próxima.					
ao trabalho.					
à escola/ universidade.					
a serviços (ex. hospitais e centros de saúde, escolas, correios, banco, finanças,					

conservatória, etc.).					
a atividades culturais (ex. museus, exposições, cinema).					
a atividades de lazer ocorridas durante o dia (ex. parques, passeios, restaurantes).					
a eventos sociais ocorridos durante a noite (ex. jantares com amigos, cinema, concertos, discotecas).					
a eventos com grandes concentrações de pessoas (ex. festivais, jogos de futebol).					
a atividades com pessoas dependentes de mim (ex. crianças, idosos).					