



Elderly specific DRT in Italy and Japan: the factors influencing the DRT usage in Genoa and Toyoake City

Tiziano Pavanini¹, Yukimasa Matsumoto², Claudia Burlando³, Tatsuki Nakanishi⁴

¹ Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milan, Italy, tiziano.pavanini@polimi.it

² Department of Civil Engineering, Meijo University, 1-501 Shiogamaguchi, Tenpaku, Nagoya City 468-8502, Japan, matumoto@meijo-u.ac.jp

³ Department of Economics and Business, University of Genoa, Via Francesco Vivaldi, 5, 16126 Genoa, Italy, claudia.burlando@unige.it

⁴ Department of Civil Engineering, Meijo University, 1-501 Shiogamaguchi, Tenpaku, Nagoya City 468-8502, Japan

Abstract

The ageing of the world's population is a growing phenomenon. Numerous studies have shown that mobility is a key factor for active and healthy ageing. In this context, demand-responsive transport (DRT) plays a key role, as it offers better accessibility and inclusiveness to the over-65s compared to traditional public transport, which is often under-used by the elderly. The aim of this article is to compare two DRT services for older people operating in distinct geographical and cultural contexts, such as Genoa (Italy) and Toyoake City (Japan). Two questionnaires were administered to the users in order to identify the factors influencing the increase in DRT usage. It is then possible to suggest to decision makers what improvements should be made to increase DRT in both areas. The results show that availability of DRT and accessibility to DRT stops are key factors in both contexts.

Keywords Demand Responsive Transport; DRT; elderly mobility; accessibility.

1. Introduction

According to the World Health Organization (WHO, 2022) the global population is aging at an unprecedented pace: experts predict that by 2030, 1 in 6 people in the world will be over 60 and that the global share of elderly people is shifting from 1 billion to 1.4 billion in just one decade (2020-2030). To better address this phenomenon at a global level, WHO created a program of policies and measures developed in collaboration with member states, called "The Decade of Healthy Aging 2020-2030", aimed at supporting each country in tackling the economic and social implications that this trend entails (Rudnicka et al., 2020).

* Presenting author

E-mail address: tiziano.pavanini@polimi.it

In a scenario of this type, mobility plays a key role in contrasting the social and economic marginalization that the retirement phase can entail for the elderly. In this regard, active aging policies, defined as "the process of optimizing health, participation and safety opportunities to improve the quality of life of aging people" (WHO, 2002), guarantee the elderly good health, psychological well-being, and increased happiness (Thaithakul et al., 2022). To ensure equal accessibility to urban services for all segments of the population, including the elderly, local public transport (LPT) plays a fundamental role: however, local administrations often fail to consider the needs of the elderly when planning urban mobility (Wong et al., 2018).

Such oversight by local governments leads to difficulties in public transport use by the elderly who often end up avoiding its use altogether. For years, academic research has been involved in understanding the main factors limiting the accessibility of the elderly to urban services and spaces: main issues identified concern the inadequacy of shelters, the driving habits of drivers and the punctuality of vehicles (Lan et al., 2022), the lack of priority seats and the cost of tickets (Wong et al., 2018), the poor quality of infrastructure, an inadequate customer care policy, and a lack of respect for the elderly (Kunaka, 2022). Sun and Lau (2021) note that main barriers to public transport are related to pedestrian access to stations: barriers include crowded footpaths and railings between the road and the pavement. Furthermore, the perceived quality of LPT and the neighbourhood of residence are important factors in older adults' decisions to use public transport and participate in community social activities (Mariotti et al., 2021).

One of the most valid solutions to address the accessibility limitations of older people to traditional public transport is Demand Responsive Transport (DRT), a flexible mode of transport that operates based on users' mobility needs (Campisi et al., 2023), usually using minibuses. It has been defined in the literature as "an intermediate form of transport, somewhere between bus and taxi which covers a wide range of transport services ranging from less formal community transport through to area-wide service networks" (Mageean and Nelson, 2003).

The academic literature that has focused on elderly-specific DRT solutions has so far looked at them only at a local level, losing sight of the differences or similarities that emerge in different contexts.

Thus, this paper investigates the DRT transport preferences and attitudes of the elderly residing in two areas geographically and culturally distant from each other: Italy and Japan, the first two countries in the world with the highest share of elderly people, respectively 23% and 28% (Population Reference Bureau, 2023). To fill the gap in literature, this work intends to study the effects of the implementation of two elderly-specific DRT case studies conducted in Genoa (Italy) and in Toyoake City (Japan): results were collected by administering a questionnaire to users of both contexts. This study aims to understand which factors are influencing the increase in DRT usage, and consequently it is possible to suggest to decision-makers what improvements should be made to increase DRT usage. While some literature exists on elderly mobility, there is very limited research specifically focused on elderly-oriented DRT services.

This manuscript consists of five sections. "Introduction" aims to outline the research context and purpose of this study. "Literature review" reports the background research conducted so far on the accessibility of the elderly and on elderly-specific DRT. Section three, "Outlines of research areas", presents the two study areas and the structure of the questionnaires while the results are displayed in Section 4 ("Analysis results and

discussion”). Section 5 is “Conclusions” which expresses the conclusions, limitations and future agenda of this study.

2. Literature Review

The mobility and transport need of the elderly population is receiving increasing attention in the literature, where the topic has been treated from different points of view in recent years.

The prevalence of scientific articles focuses on the study of the elderly accessibility to the essential urban services (e.g. hospitals, post offices, banks, grocery shops, etc.). For this reason, the literature review in this section focuses mainly on the issue of accessibility of public transport for older people, in order to highlight its relevance in combating social and economic isolation, the current critical issues and the strong urgency of creating dedicated transport.

The need to create urban spaces in the city suitable for the needs of the elderly is relevant to the literature. In this regard, Mariotti et al. (2021), aware of the relevance that movement and social interaction have for the psychological well-being of the elderly, examine the factors that lead an aged statistical sample from Milan and Genoa, Italy, to stop traveling and participating in activities due to the lack of perceived appropriate local public transportation. This study, conducted using multivariate logistic regression models, highlights the relevance of a quality public transportation service to decision makers, as satisfaction with public transportation is one of the most important elements in the choice of the elderly to undertake a trip or not.

Burlando and Cusano (2018) argue that the elderly can enjoy the urbanization economies typical of cities, if they have easy access to the services offered by these areas. In this regard, the urban mobility planning phase is crucial: although there is still a deeply rooted car culture in Italy, data show that the elderly would be willing to use public transport at the expense of the car, as long as this is safe, cheap, and accessible. In order to improve the health, well-being, and general quality of life of the elderly population, the study highlights the need for decision-makers to consider their needs and offer accessible public transport capable of promoting their mobility and social integration.

Some scholars study the accessibility of the elderly population to some urban spaces considered not essential by most of the literature but of crucial importance in terms of psychological well-being and active aging of the residents. In that regard, the problem of unequal distribution of urban resources is investigated by Wang et al. (2022), who conducted a research through focus groups and spatial analysis in three districts of the Kwun Tong (Hong Kong), to understand the variables that influence the access of elderly citizens to community facilities. The aforementioned results of the academic literature indicate the importance for the elderly, in psychological and health terms, of maintaining an active life full of social interactions. In this process, the efficiency of public transport plays a key role as it allows people in possession of a driving license to abandon the use of their car, with positive effects also on urban traffic and the environment, and those without a driving license to avoid social isolation.

However, as abovementioned, some issues prevent seniors from fully utilizing fixed transportation. Historically, Patterson (1985) conducted one of the first studies to understand the factors that influence elderly's perceptions of satisfaction or dissatisfaction with public transport. This research, carried out almost 40 years ago, revealed the existence of some barriers that still exist today, while others have been removed over

time. The results point to three categories of barriers: physical (e.g. too high steps to get on buses, bus stops without benches, lack of shelter at bus stops, etc.), psychological (e.g. fear of violence on board, etc.) and a mix of the two (overcrowded buses, lack of patience on the part of drivers, etc.).

According to Broome et al. (2012), the main obstacles to using public transportation are the distance from the stations, the inadequate walkways, and the lack of sufficient shelters. Due to the aforementioned barriers to the full use of conventional transport and the specific mobility needs of older adults, it is crucial that public transport authorities and decision makers implement specific transport solutions such as DRT. To date, there is very little literature on the topic of elderly-specific DRT.

A pioneering study in this area was conducted by Westerlund et al. (2000) on a DRT service for the disabled and elderly ("Flexlinjen") that was active in Gothenburg, Sweden, at the beginning of the millennium. The aim of this research was to validate the user acceptance of innovative features for the time, such as the introduction of automatic booking for return trips. The results of the study showed a very high level of acceptance of new features and technologies by older users.

Despite the benefits for both the transport operator and the user, the main obstacle to the full diffusion of DRT on a global scale is the excessive cost, especially for more flexible service models (Enoch et al., 2006; Currie and Fournier, 2020). For this reason, Leliveld (2022) investigates the dependence of elderly people on DRT and looks for solutions to attract them to cheaper traditional transport. This study, conducted in the rural area around Groningen, the Netherlands, shows that the demand for DRT could be reduced if conventional bus stops were closer to the population centres where older people live and their main destinations.

2.1 Key theory

The key theory underlying this work is based on the assumption that the attitudes of older adults towards public transport vary considerably depending on geographical, personal and cultural contexts (Srichuae et al., 2016; Böcker et al., 2017). These variations are influenced by a range of socioeconomic, infrastructural and psychological factors. In some geographical areas, especially in well-developed cities, public transport is readily available and covers a large area, thereby facilitating mobility for older adults. In other contexts, such as in rural or less developed areas, the LPT may be limited or difficult to access, forcing the elderly to rely on private transport or to limit their travel (Zhang et al., 2018).

The concept of mobility culture is of significant importance. In some cultures, the utilisation of public transport is highly esteemed and socially accepted, even among older adults. In other contexts, however, there is a greater emphasis on the use of private vehicles, and public transport may be considered a less desirable option, especially for the elderly. Moreover, in Eastern countries (e.g. China), elderly individuals are more likely to reside with their children and grandchildren, which influences their transportation preferences (Feng, 2017). In these countries, they are more frequently transported as passengers by their children than in Western countries, where they are typically regarded as more independent (e.g. The Netherlands) (Böcker et al., 2017).

Socioeconomic factors, such as income and social status, exert a significant influence on these attitudes (Somrongthong et al., 2017). In the absence of private alternatives, older adults with limited economic resources may be more reliant on public transport. In

contexts where car ownership is prevalent and regarded as a symbol of independence, older adults may opt to drive rather than utilise public transportation.

Furthermore, public policies exert a significant influence (Arranz et al., 2022). In some regions, specific policies have been implemented to encourage the use of public transport among older adults, such as discounted fares or the provision of specialised services. In contrast, in other regions where such policies are absent, older adults may be less inclined to utilise public transport. Ultimately, psychological and physical conditions and habits that have been developed over the course of a lifetime can have markedly disparate impacts on decisions regarding the use of public transport. This can vary considerably depending on the cultural and geographical context of the individual in question (Truong and Somenahalli, 2015; Al-Rashid et al., 2021; Crotti et al., 2021).

3. Outlines of research areas

After a very brief analysis of the literature review, it is necessary to contextualise the research areas of this study.

SilverBus was a DRT service for senior citizens, piloted from July to December 2022 in two neighbourhoods of the Italian city, Genoa (almost 600,000 inhabitants), with the greatest presence of over-65s (29.1%). This trial used a small vehicle with seats reserved for older people. The service was free of charge and there were hostesses on board who were able to welcome users and give them instructions on how to book the service (i.e. call centre or app). The origin and destination of the trip had to be within the test area. To evaluate the level of user satisfaction and the performance of the service, a questionnaire was administered to users in February 2023 using CATI (Computer Assisted Telephone Interview) methodology (250 valid interviews). The structure of the questionnaire consisted of 4 modules (socio-demographic profile; satisfaction with the service; travel habits; willingness to pay).

On the other side, Toyoake City is in Aichi Prefecture, central Japan, and developed itself as a bed town adjacent to Nagoya City, having a population of over 2.3 million. As of April 2023, the population of Toyoake City is 30,794, and the aging rate is 25.9%. Choisoko introduced in Toyoake City is a DRT service operated by Aisin Corporation. To use this transportation service, citizens need to register as a member, and they must primarily be over 64 years old or with a disability certificate. This transportation service can be used from 9:00 a.m. to 4:00 p.m. on weekdays, and the fare is 200 yen. Reservations can be made by phone or the Internet. To evaluate the same factors as SilverBus, a questionnaire was distributed to users of Choisoko in December 2023: it was distributed to all 1,644 member households from late November to early December 2023, and the number of responses was 482, with a response rate of 29.2%.

In Table 1 are summarized the key characteristics of the two services and questionnaires conducted.

Table 1. Key characteristics of DRT services and questionnaires conducted

Feature	SilverBus (Genoa, Italy)	Choisoko (Toyoake, Japan)
DRT Services		

Activity period	July – December 2022 (trial)	Active as of April 2023
Location	Two neighbourhoods in Genoa	Toyoake City (Aichi Prefecture)
Ageing rate	29.1%	25.9%
Target users	Citizens over 65	Citizens over 64 or with a disability certificate
Type of vehicle	Small vehicle with reserved seats for elderly	Small vehicle with reserved seats for elderly
On-board presence	Hostesses on board to welcome and assist with booking	No presence of hostesses
Service cost	Free of charge	200 yen – 1500 yen depending on travel distance
Operating hours	7:15 a.m. – 1:00 p.m. and 2:00 p.m. – 7.45 p.m. everyday	9:00 a.m. – 5:30 p.m. on weekdays and Saturday
Booking methods	Call center or app	Phone
Questionnaires' characteristics		
Evaluation method	Computer Assisted Telephone Interview (CATI)	Questionnaire, Mail distribution (1 sheet for one household with at least one resister of Choisoko Toyoake), mail collection
Survey date	February 2023	Late November – early December 2023
Valid responses	250	482
Gender of respondents	77% females 23% males	72.2% females 27.8% males
Age of respondents	65-69 years 18% 70-74 years 22% 75-79 years 26% 80 + years 34%	6.5% under 65 years old, 17.9% in the early stage elderly, 75.6% in the late stage elderly
Questions used exclusively for the purposes of this research.	<ol style="list-style-type: none"> 1. Do you have a valid driver's license? 2. What transportation modes do you currently use on a daily life? 3. What is your level of satisfaction with Choisoko/SilverBus for each of the following factors? 4. If you do not use Choisoko/SilverBus (or have stopped using them), what is the reason? 	

4. Analysis results and discussion

The operational services in Genoa and Toyoake were therefore compared based on four key aspects: possession of a driving licence (Figure 1), means of transportation used on a

daily trip (Figure 2), satisfaction with DRT operation (Figure 3), reason for not using DRT (Figure 4).

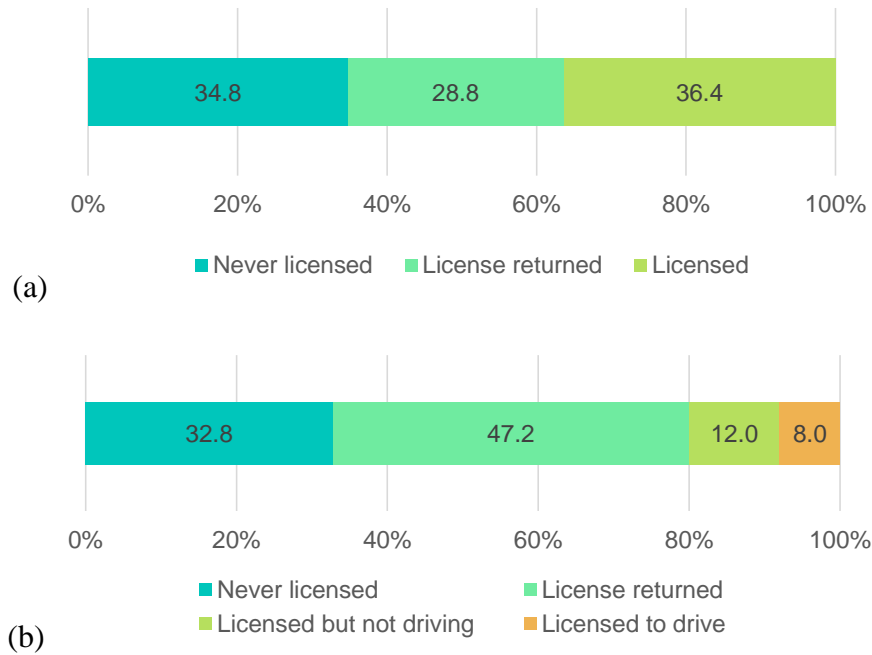


Figure 1. Possession of driving license - (a) Genoa; (b) Toyoake.
Source: own elaboration

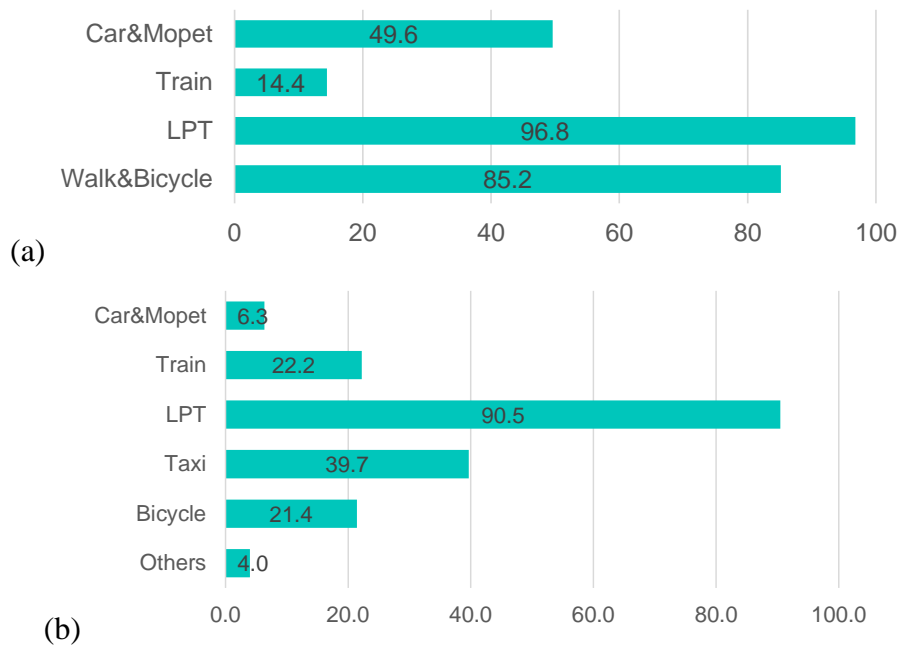


Figure 2. Means of transportation usually used - (a) Genoa; (b) Toyoake.

Source: own elaboration

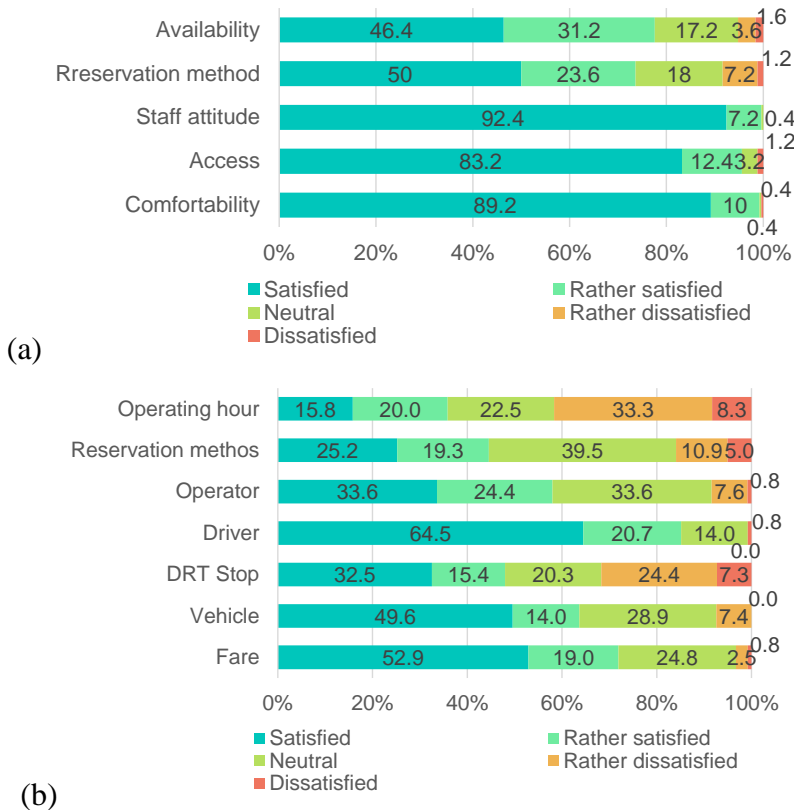


Figure 3. Satisfaction for DRT - (a) Genoa; (b) Toyoake.

Source: own elaboration

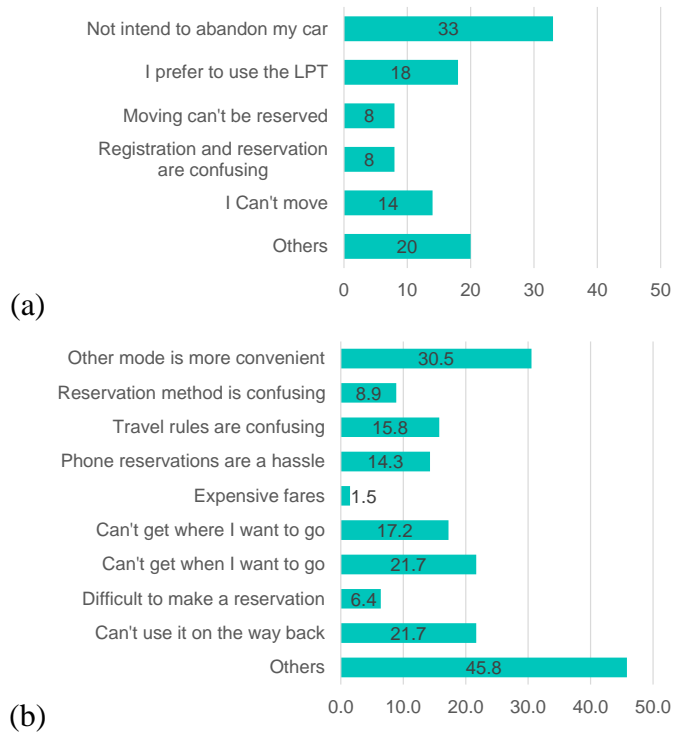


Figure 4. Reason for not using DRT - (a) Genoa; (b) Toyoake.

Source: own elaboration

Figure 1 shows that in both contexts, people without a driving licence represent a significant proportion of the respondents (34.8% in Genoa and 32.8% in Toyoake). However, there is a significant difference with regard to those who still have a driving licence: in Genoa, they represent the majority (36.4%), whereas in the Japanese city, if those who have a driving licence, but do not drive are added to those who drive, they represent only 20%. Figure 2 shows the means of transportation usually used by the users: LPT is clearly the preferred means of transportation in both contexts. In Genoa, walking and cycling are in second place, while in Toyoake it is the taxi (the bicycle is in fourth place). In Genoa, the use of private transportation represents a much larger share of users than in Toyoake (49.6% versus 6.3%). Figure 3 shows the level of user satisfaction in the two contexts: in Genoa, the attitude of the staff and the comfort on board are highly appreciated, the hourly availability of vehicles and the ease of booking need to be improved. In Toyoake, the highest score was given to the driver, followed by the fares and conditions of the vehicle: here too, the hourly availability of the vehicles and the booking methods need to be improved. Among the reasons for not using the DRT (Figure 4), in Genoa users mainly prefer to travel with their own car or with the traditional LPT, while in Toyoake older people would like a better service with improved scheduling flexibility and convenience.

Figure 5 shows the relationship between the change in SilverBus usage and the satisfaction of each factor, where the horizontal axis denotes the average of the satisfaction for each factor and the vertical axis denotes the values of Cramer's V. Cramer's V shows the correlation strength between two factors. Red lines show the average of each value. There are four areas divided by red lines. The factors in the upper right area are ones whose relatively high satisfaction is linked to an increase in the DRT usage, and therefore are not required to improve. On the other hand, the relatively low satisfaction level of factors in the upper left area has led to a decrease in the frequency of the DRT usage, and improvements to these factors are required. Factors in the lower right and lower left areas have a relatively small relationship with changes in the DRT usage, and improvements in these factors will not have a large effect on increases or decreases in the DRT usage.

From this figure, "Availability" should first be improved to increase the number of SilverBus usages. "Access" to DRT stops should also be improved. It is expected that the number of buses will be increased, and more DRT stops will be placed. The high satisfactions in "Professionalism", "Steward efficiency", and "Punctuality" have positive effects for increasing the number of *SilverBus* usages during the experiments.

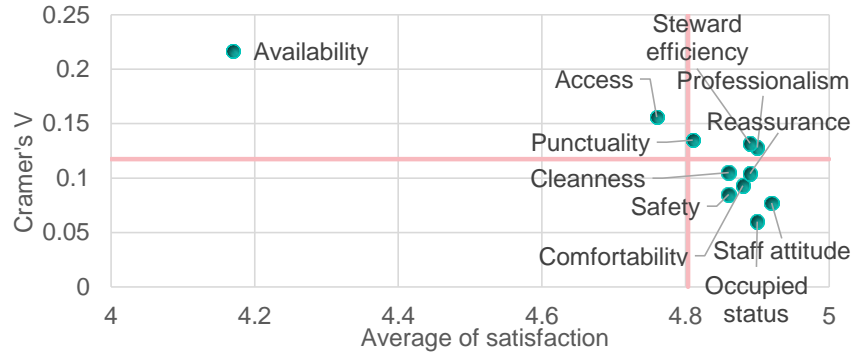


Figure 5. Relationship between SilverBus usage and satisfaction.
Source: own elaboration

Figure 6 shows the relationship between the change in the number of outings and the satisfaction of each factor in the Choisoko service. From this figure, the operating day and DRT stop should be improved to increase the number of going out. It is expected that Choisoko will also be operated at weekends and that more DRT stops will be set up. The high ratings for vehicle and fare have a positive effect on increasing the number of Choisoko members going out.

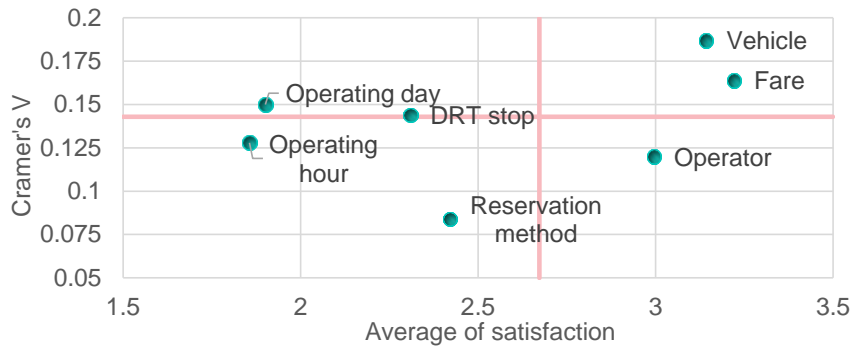


Figure 6. Relationship between Choisoko usage and satisfaction.
Source: own elaboration

A comparison of the two figures reveals that, in both contexts, the availability of the service plays a crucial role in the increased use of services by the elderly: this is important because the expansion of supply in LPT does not always result in increased demand, as is the case here. In both case studies, the public transportation authority can leverage this element by investing in the purchase of new vehicles or spreading the service across multiple time periods and whole days a week. Another factor that affects the use of services in both cases is the accessibility of the stops. Elderly people should not have any difficulty reaching the nearest stops. Placing more stops could alleviate difficulties for the elderly. This can be done to increase both the use of the service and the number of trips by the elderly.

5. Conclusions

This study recommends that policymakers enhance the availability of DRT, as it appears to be a critical factor in increasing usage among the elderly in two contrasting contexts. The users want to book DRT whenever they want to go out, so operating enough

number of DRT vehicles from morning to night every day is strongly desired. Although this trend may appear self-evident, it is important to recognise that the increased availability of DRT vehicles and higher hourly frequency can encourage use; however, this does not automatically guarantee a significant increase in usage without the implementation of additional measures. While greater availability of DRT may theoretically enhance accessibility and reduce waiting times, a number of factors can influence user response (Zailani et al., 2016; Gascon et al., 2020). The quality of the service, the travel habits of the elderly and the efficacy of promotional campaigns are of pivotal importance in this regard. In the case of Silverbus, for example, the service awareness survey conducted post-trial revealed that 80% of residents in the area were unaware of the existence of the service due to an insufficient advertising campaign. Among the respondents, 46% indicated that had they been aware of the Silverbus service, they would have utilized it for their daily commuting needs.

The accessibility of DRT stops is also important factors in increasing DRT usage. The users expect DRT as transportation means for the first/last one mile, so more DRT stops are required near their homes and sidewalks leading to the stops are also improved. Although these improvements are expected to increase in the DRT usage for the elderly, there are concerns about an increase in public subsidies through taxes. Therefore, it is necessary to set a specific purpose of introducing DRT and the LOS as a public service that reflects the characteristics of the area, and to proceed with such improvements rather than simply responding to requests from DRT users. In addition, further research would be necessary to assess the willingness of elderly to pay for the co-financing of such DRT services.

References

- Al-Rashid, M. A., Goh, H. C., Harumain, Y. A. S., Ali, Z., Campisi, T., & Mahmood, T. (2021). Psychosocial barriers of public transport use and social exclusion among older adults: Empirical evidence from Lahore, Pakistan. *International journal of environmental research and public health*, 18(1), 185.
- Alidoust, S., Bosman, C., & Holden, G. (2019). Planning for healthy ageing: How the use of third places contributes to the social health of older populations. *Ageing & society*, 39(7), 1459-1484.
- AMT (2024). Accessed on <https://www.amt.genova.it/amt/wp-content/uploads/2022/09/pannello-70x50-1-2.pdf>
- Arranz, J. M., Burguillo, M., & Rubio, J. (2022). Are public transport policies influencing the transport behaviour of older people and economic equity? A case study of the Madrid Region. *Research in transportation economics*, 95, 101218.
- Böcker, L., van Amen, P., & Helbich, M. (2017). Elderly travel frequencies and transport mode choices in Greater Rotterdam, the Netherlands. *Transportation*, 44, 831-852.
- Broome, K., Worrall, L., Fleming, J., & Boldy, D. (2012). Evaluation of flexible route bus transport for older people. *Transport Policy*, 21, 85-91.

- Burlando, C., & Cusano, I. (2018). Growing Old and Keep Mobile in Italy. Active Ageing and the Importance of Urban Mobility Planning Strategies. *TeMA-Journal of Land Use, Mobility and Environment*, 43-52.
- Campisi, T., Cocuzza, E., Ignaccolo, M., Inturri, G., Tesoriere, G., & Canale, A. (2023). Detailing DRT users in Europe over the last twenty years: A literature overview. *Transportation Research Procedia*, 69, 727-734.
- Choisoko (2024). Accessed on <https://www.choisoko.jp/toyoake/communication/vol-16/>
- Crotti, D., Maggi, E., Pantelaki, E., & Rossi, F. (2021). Public transport use and health status in later life: Which relationship?. *Research in Transportation Business & Management*, 40, 100591.
- Currie, G., & Fournier, N. (2020). Why most DRT/Micro-Transits fail—What the survivors tell us about progress. *Research in Transportation Economics*, 83, 100895.
- Enoch, M., Potter, S., Parkhurst, G., & Smith, M. (2006). Why do demand responsive transport systems fail?
- Feng, J. (2017). The influence of built environment on travel behavior of the elderly in urban China. *Transportation research part D: Transport and environment*, 52, 619-633.
- Gascon, M., Marquet, O., Gràcia-Lavedan, E., Ambròs, A., Götschi, T., de Nazelle, A., ... & Nieuwenhuisen, M. J. (2020). What explains public transport use? Evidence from seven European cities. *Transport Policy*, 99, 362-374.
- Guida, C., Carpentieri, G., & Masoumi, H. (2022). Measuring spatial accessibility to urban services for older adults: an application to healthcare facilities in Milan. *European Transport Research Review*, 14(1), 23.
- Jittrapirom, P., van Neerven, W., Martens, K., Trampe, D., & Meurs, H. (2019). The Dutch elderly's preferences toward a smart demand-responsive transport service. *Research in Transportation Business & Management*, 30, 100383.
- Kunaka, B. G. (2022). Prioritising User-Friendly Urban Public Transport for the Zimbabwean Elderly. *Journal of Urban Systems and Innovations for Resilience in Zimbabwe-JUSIRZ*, 4(1), 221-239.
- Lan, J., Xue, Y., Fang, D., & Zheng, Q. (2022). Optimal Strategies for Elderly Public Transport Service Based on Impact-Asymmetry Analysis: A Case Study of Harbin. *Sustainability*, 14(3), 1320.
- Leliveld, P. (2022). Accessibility for the elderly in the province of Groningen (Doctoral dissertation).
- Mageean, J., & Nelson, JD (2003). The evaluation of demand responsive transport services in Europe. *Journal of Transport Geography*, 11 (4), 255-270.
- Mariotti, I., Burlando, C., & Landi, S. (2021). Is Local Public Transport unsuitable for elderly? Exploring the cases of two Italian cities. *Research in Transportation Business & Management*, 40, 100643.
- Patterson, A. H. (1985). Fear of crime and other barriers to use of public transportation by the elderly. *Journal of Architectural and Planning Research*, 277-288.
- Pinto, M. D. T. (2020). Exploring the Potential of DRT for Elderly Urban Mobility using Big Data (Doctoral dissertation, Universidade do Porto (Portugal)).
- Population Reference Bureau (2023), Countries with the oldest populations in the world. <https://www.prb.org/resources/countries-with-the-oldest-populations-in-the-world/>.

- Rudnicka, E., Napierała, P., Podfigurna, A., Męczekalski, B., Smolarczyk, R., & Grymowicz, M. (2020). The World Health Organization (WHO) approach to healthy ageing. *Maturitas*, 139, 6-11.
- Somrongsong, R., Wongchalee, S., Ramakrishnan, C., Hongthong, D., Yodmai, K., & Wongtongkam, N. (2017). Influence of socioeconomic factors on daily life activities and quality of life of Thai elderly. *Journal of public health research*, 6(1), jphr-2017.
- Srichuae, S., Nitivattananon, V., & Perera, R. (2016). Aging society in Bangkok and the factors affecting mobility of elderly in urban public spaces and transportation facilities. *Iatss Research*, 40(1), 26-34.
- Sun, G., & Lau, C. Y. (2021). Go-along with older people to public transport in high-density cities: Understanding the concerns and walking barriers through their lens. *Journal of Transport & Health*, 21, 101072.
- Thaithatkul, P., Chalermpong, S., Laosinwattana, W., & Kato, H. (2022). Mobility, activities, and happiness in old age: case of the elderly in Bangkok. *Case Studies on Transport Policy*, 10(2), 1462-1471.
- Truong, L. T., & Somenahalli, S. V. (2015). Exploring frequency of public transport use among older adults: A study in Adelaide, Australia. *Travel Behaviour and Society*, 2(3), 148-155.
- Wang, S., Esther, H. K. Y., Yu, Y., & Tsou, J. Y. (2022). Right to the city and community facility planning for elderly: The case of urban renewal district in Hong Kong. *Land Use Policy*, 114, 105978.
- Westerlund, Y., Stahl, A., Nelson, J., & Mageean, J. (2000). Transport telematics for elderly users: Successful use of automated booking and call-back for demand responsive transport services in Gothenburg. In *Proceedings of the 7th World Congress on Intelligent Systems*.
- Wong, R. C. P., Szeto, W. Y., Yang, L., Li, Y. C., & Wong, S. C. (2018). Public transport policy measures for improving elderly mobility. *Transport Policy*, 63, 73-79.
- World Health Organization. (2002). Active ageing: a policy framework. World Health Organization. <https://apps.who.int/iris/handle/10665/67215>
- World Health Organization (2022). Ageing and health. [https://www.who.int/news-room/fact-sheets/detail/ageing-and-health#:~:text=By%202030%2C%201%20in%206,will%20double%20\(2.1%20billion\)](https://www.who.int/news-room/fact-sheets/detail/ageing-and-health#:~:text=By%202030%2C%201%20in%206,will%20double%20(2.1%20billion)).
- Zailani, S., Iranmanesh, M., Masron, T. A., & Chan, T. H. (2016). Is the intention to use public transport for different travel purposes determined by different factors?. *Transportation Research Part D: Transport and Environment*, 49, 18-24.
- Zhang, Y., He, Q., Wu, W., & Li, C. (2018). Public transport use among the urban and rural elderly in China. *Journal of Transport and Land Use*, 11(1), 701-719.

Acknowledgements

A part of this study has been supported by JSPS KAKENHI Grant Number 22K04357.