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A Mystery Shopping Survey Tool to Address the Needs of Vulnerable Users at Bus Public Transport Stops

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ABSTRACT: The Quality-of-Service (QoS) criteria for public transport are not consistently met for all passengers, particularly vulnerable groups such as women, older adults, and people with disabilities. Women frequently travel for caregiving, carry heavy items, and travel with children, underscoring the need for improved accessibility conditions and customer care. Additionally, they face risks of assault and harassment, particularly in overcrowded environments, which have worsened during the COVID-19 pandemic. Older public transport users prioritize safety, accessibility, and comfort, with key concerns including easy access, comfortable seating, and little noise. Fear of falling and anxiety, exacerbated by factors like high steps and poor design, can discourage the use of public transport. People with disabilities encounter substantial obstacles when using public transport due to physical barriers, including narrow sidewalks and steep inclines that may increase the risk of falling. Common issues include inadequate shelters, poor lighting, and the inaccessibility of vehicles. Many individuals with disabilities prefer short waiting times at bus stops due to vulnerability, but they often experience bullying and stigma on public transport. Public transport is vital for achieving the UN 2030 Agenda for Sustainable Development. Expanding public transport must meet the needs of vulnerable groups, including women, children, older adults, and persons with disabilities (Target 11.2). In this paper, we have highlighted the QoS factors that influence passenger waiting experiences at bus stops, which often significantly affect the choice of public transport as a travel option. We identified the QoS criteria pertinent to bus stops and outlined methods for evaluating quality based on established public transport standards. In accordance with the latest strategic objectives of the UN 2030 Agenda, which seeks to establish inclusive public transport that offers accessible and comfortable services for vulnerable users—including women, older adults, and individuals with disabilities—we associated each QoS factor at bus stops with specific quality assessment checks. Additionally, we created a mystery shopping survey instrument in the form of a structured checklist. This checklist comprises 15 categories of QoS evaluations and clear instructions for conducting pertinent audits by trained researchers. The design and content of the mystery shopping checklist make it a useful tool for assessing QoS at bus stops. It also enables the documented recognition of service shortcomings, facilitating the rational prioritization of investments to improve service quality in public transport, particularly for integrating vulnerable groups within the community.

KEYWORDS: Quality of service; Sustainable Development Goal; Older adults; Women; People with disabilities

1. INTRODUCTION

Public transport continues to be a top priority on the intergovernmental agenda for tackling air pollution, energy transition, and climate change (UN, 2021). The most recent data from the International Association of Public Transport (UITP) indicates that buses are the most widely used mode of public transport, accounting for 63% of all public transport trips worldwide (UITP, 2017). The arrangement and design of bus stop facilities are key components of public transport systems. The placement of bus stops significantly affects travel time, as it impacts walking distances to and from stops, commercial speed, and ultimately, the Quality of Service (QoS) and ridership (Kopsacheilis et al., 2023; TCRP, 1996; Tsioulianos et al., 2020). Public transport is only a viable travel option if the stops are located within a reasonable walking distance from travelers' origin and destination points (TCRP, 2013; UN, 2021). In fact, the distance individuals are willing to walk to a bus stop often depends on sociodemographic and trip-specific factors, including age, sex, physical abilities, pedestrian facilities, built environment, and terrain (Alshalalfah & Shalaby, 2007; Tsioulianos et al., 2020; El-Geneidy et al., 2010; TCRP, 2013). Additional features that enhance comfort and convenience at bus stops—such as shelters, seating areas, and a layout that ensures safety and security—also influence a person's decision and ability to travel by public transport (TCRP, 2013).

Public transport is crucial for achieving the UN 2030 Agenda for Sustainable Development. Creating inclusive, safe, resilient, and sustainable cities and human settlements (Goal 11) relies on expanding public transport systems. This expansion must pay particular attention to the needs of vulnerable groups, including women, children, persons with disabilities, and older adults (Target 11.2). Many areas still lack adequate public transport infrastructure. Even where systems are in place, they may not be accessible, affordable, or safe for everyone. This is particularly true for marginalized populations, such as people with low incomes, women and girls, older individuals, and those with disabilities (UN, 2021). Currently, only 49.5% of urban residents worldwide have convenient access to public transport (UN-Habitat, 2018). The UN 2030 Agenda for Sustainable Development aims to improve access to convenient public transport for vulnerable individuals by monitoring Indicator 11.2.1, which measures the proportion of the population with convenient access to public transport, broken down by sex, age, and persons with disabilities. According to the UN, convenient access means having a bus or tram stop within a 500-meter walking distance and a metro or train station within 1 kilometer (UN, 2021). Additionally, public transport is characterized as convenient when: (a) it is accessible to individuals with special needs, including those with disabilities, older adults, children, and vulnerable groups; (b) services are frequent during peak hours; and (c) stops and stations ensure safety and comfort (UN-Habitat, 2018).

This paper examines the QoS factors at bus stops and proposes a mystery shopping survey tool that public transport practitioners can use to comprehensively assess the bus

stop environment. The focus will be on vulnerable users, i.e., women, older adults, and people with disabilities, in alignment with the goals of the UN 2030 Agenda. With this tool, public transport agencies may be able to determine the gap between targeted and delivered QoS (CEN/TC 320, 2001) by obtaining objective measurements and assessments of the QoS attributes that have a critical role in the travel experience of vulnerable passengers.

The following section outlines the fundamental principles of measuring and assessing QoS in public transport systems. It also discusses the basic characteristics of bus stop environments and the needs of vulnerable passengers. The development of the proposed mystery shopping survey tool is described in Section 3, and the complete checklist is presented in the Appendix. Section 4 discusses the main conclusions of this study.

2. BACKGROUND

2.1 Quality of public transport services

According to the Transit Capacity and Quality of Service Manual, the indicator that describes the degree to which the offered service in a public transport system meets the passengers' needs is called QoS and is defined as "The overall measured or perceived performance of transit service from the passenger's point of view" (TCRP, 2013). The QoS of public transport systems can be evaluated through a set of criteria. According to the relevant European Standard, those criteria can be classified into the following eight (8) categories (CEN/TC 320, 2001; TCRP, 2013):

– Availability: Public transport usage is closely linked to service availability near passengers' origins/destinations, with adequate frequency and timing. If these conditions are not met, potential passengers may opt for other modes of transport or choose not to travel. Spatial availability is essential, given the varying building densities in urban and suburban areas, which can increase walking distance to public transport stops in less densely populated regions. Temporal availability includes service frequency and hours. Public transport capacity is defined by its ability to accommodate passenger demand. When a public transport vehicle arrives at a stop, and there is insufficient space for waiting passengers, the consequences can include longer waiting times if they must wait for the following vehicle, a decrease in the QoS due to limited interior space, which can lead to a reduced sense of security and comfort.
– Accessibility: Accessibility in public transport refers to how easily people can reach and use the systems and access other modes of transport before or after their public transport trip. This concept is often examined differently based on the type of user, such as pedestrians or private car users. Additionally, accessibility includes the public transport system's ticketing process and how straightforward it is for passengers to obtain tickets.
– Information: Passengers need to be informed about the available public transport boarding points and stops, the departure and arrival times, the disembarkation point or stop that is closer to their destination, and the route to their final destination point. Information can be provided to the passengers in various ways, including (a) printed material at selected locations, (b) posted information at stops/stations, (c) audio announcements at stations or inside the vehicles, (d) visual announcements to assist especially hearing-impaired passengers, (e) information via telephone, (f) 24-hour information via the internet or mobile application, and (g) real-time information using display screens available at stations and/or stops. Available information must encompass all aspects of the jour-

ney, including the planning stage, the route itself, and reaching the passenger's final destination.
– Time: This QoS criterion relies on a variety of factors, including current road traffic and unexpected events, the quality and maintenance of public transport vehicles, the quality of the road network (such as the availability of bus lanes and their operation mode), passenger flow and demand, trip length, and the total number of stops along the route. The evaluation of travel time, as a QoS criterion, pertains to both the scheduled and actual duration of a trip, as well as the various travel periods involved in the journey (walking time to reach the bus stop, waiting time, in-vehicle travel time, etc.).
– Customer Care: Effective and consistent customer service relies significantly on the services offered by the public transport agency. The availability of staff, the establishment of information points throughout the public transport network, and the careful management of passenger complaints and requests all play a crucial role in making a public transport system user-friendly. These factors also affect the level of trust potential customers have in the system.
– Comfort: Clean and inviting public transport stops, stations, and vehicles enhance the overall image of a public transport system for both users and non-users. Strategically placing public transport stops in areas with high private car traffic informs drivers about the available public transport network and may attract more passengers. In contrast, neglected and damaged bus stops can deter potential users and raise concerns about the QoS provided. Passenger comfort inside vehicles is influenced by several factors, including a pleasant temperature, which is maintained through air conditioning, and an inviting, well-designed interior that features comfortable seating and special spaces for children or individuals with specific needs. Additionally, the comfort experienced during the vehicle's movement is affected by factors such as acceptable acceleration levels, braking, vibrations, and noise.
– Security: The reduced risk of being involved in a traffic accident, whether on board or before/after a trip, contributes to passengers' sense of security. Additionally, measures taken to prevent passengers from becoming victims of criminal acts during their travels play a crucial role. This can be achieved by ensuring that stops are well-lit and secure, equipped to handle emergencies, not left deserted, and monitored by other passengers or public transport staff during all operating hours.
– Environmental impact: While public transport is an environmentally friendly mode, compared to private cars, operators and relevant authorities should ensure that both the utilized vehicles and the service's design have the least possible impact on the environment and urban infrastructure.

QoS assessment is a comprehensive process involving two closely related types of measurements to evaluate different aspects of service delivery. The first aspect examines the difference between what is targeted and what is actually delivered. This evaluation is carried out through performance measurements, which can be done in two distinct ways. The first method is direct performance measurement, where specific indicators such as reliability, punctuality, and travel speed are estimated to gauge how well the service meets its intended standards. The second method employs mystery shopping surveys, where evaluators anonymously engage with the service to assess its quality objectively. The second aspect of QoS assessment looks at customer satisfaction, which involves determining the difference between what customers perceive and expect from the service. This is achieved

through customer satisfaction surveys, which gather valuable feedback from passengers about their experiences and feelings toward the service provided (CEN/TC 320, 2001).

2.2 Bus stop environment

The attractiveness of public transport often arises from several key factors, including the extensive network of routes that connect various destinations, the regularity of service that may reduce waiting times, and affordable fare prices that make travel accessible. However, additional elements significantly enhance the overall travel experience. For instance, prominent and easy-to-read signage helps passengers confidently navigate the system. Comfortable seating areas allow resting while waiting, and well-designed shelters offer protection from the sun and harsh weather conditions. Moreover, features that facilitate easy boarding and alighting, such as unobstructed curbs, contribute to a smoother experience. Real-time arrival screens provide valuable information, keeping riders informed and reducing anxiety about the following vehicle's arrival (Moran, 2022). Most bus stops are along streets and feature a waiting area integrated with the public sidewalk. They are marked with signage indicating the bus stop and may include small-scale passenger amenities depending on factors such as passenger volume, available space, and power supply. These amenities include a bench, a small shelter, bicycle parking, printed schedules, route information, and real-time bus arrival displays. Adequate lighting, either from adjacent streetlights or built into a shelter, is important for enhancing security during nighttime (TCRP, 2013). The walking environment is a key factor in securing access to public transport services, even when the bus stops are near one's origin point. Research shows that factors such as sidewalk availability, intersection density, and retail presence are linked to increased walking to public transport access points. At the same time, high vehicle volumes and large parking areas decrease it (TCRP, 2013). Additional previous research findings had demonstrated that (a) perceived waiting times were shorter when stops had benches, shelters, or nearby trees (Fan et al., 2016; Lagune-Reutler et al., 2016), (b) the installation of real-time information screens improves passenger safety and comfort at the bus stop (Watkins et al., 2011; Abenoza et al., 2018) and (c) the demand at bus-stop level increases with the installation of amenities such as benches, shelter, sidewalks, and real-time information displays (Kim et al., 2018; Tang & Thakuriah, 2012).

2.3 Understanding the needs of vulnerable public transport users

Research indicates disparities in satisfaction regarding QoS dimensions among public transport users (Sogbe et al., 2024). This variation emphasizes the importance of segmenting passenger groups, allowing transport authorities to customize services and allocate resources according to specific user needs (Sogbe et al., 2024). Similarly, the QoS criteria for accessing and using public transport are not always equally satisfied for vulnerable users compared to typical users. This inequality arises from significant differences in travel needs, physical abilities, and emotional behaviors among vulnerable groups, including women, older adults, and individuals with disabilities. Specifically:

– Women travel more frequently for caregiving and assistance-related purposes, while men travel more frequently for personal reasons (Campisi et al., 2022). Women often exhibit more complex mobility patterns than men. They tend to make multiple trips and use various routes within a smaller geographic area. This complexity can make public transport more challenging due to the necessary transfers and longer waiting times. Additionally, women frequently shoulder the responsibilities of household and caregiving tasks, often carrying heavy items and traveling with children in prams, which requires considerable physical effort. As a result, there is a need for improved accessibility in public transport interfaces, both external and internal, along with better customer care and comfort facilities. (Campisi et al., 2022). Women often face risks of assault, verbal harassment, unwanted advances, physical violence, and theft (UN, 2021). Overcrowding in public transport stops, stations, and vehicles can cause discomfort for women due to unwanted physical contact with strangers, increasing the risk of harassment (UN, 2021). Earlier research suggested that safety and security are key factors influencing the use of bus public transport and are closely linked to gender (Sogbe et al., 2024). Fear of violence and aggression often makes women reluctant to travel at night and use public transport (Li et al., 2012). Since the outbreak of COVID-19, there has been an increase in violence against women in transport (UN, 2021).

– For older public transport users, safety, accessibility, and comfort are some of the most significant concerns (Li et al., 2012; Sogbe et al., 2024). The ease of boarding and alighting from a public transport vehicle at the curb or platform level, the presence of multiple wide doors, comfortable seating with ample legroom, a smooth ride with little engine noise and vibrations during acceleration and braking, and a pleasant environment are especially important to them (TCRP, 2013). Older travelers often face functional limitations, leading to frustration, insecurity, anxiety, and a fear of falling if the design and ergonomics of stops, stations, and vehicles are poor. For instance, high steps, narrow aisles and corridors, and long escalators can exacerbate these concerns. Additionally, if buses do not stop close to the pavement, it can further hinder their ability to travel safely and confidently (Sundling, 2015). Older adults often need to stand while traveling, use a walker, or carry loads, which can lead to the cancellation or discontinuation of their trips (Sundling, 2015). Anxiety, fear, and stress levels have risen among older passengers using public transport due to the COVID-19 pandemic (Campisi et al., 2021). This category of passengers implies a higher risk of being infected with a disease when in close contact with others, whether on board or at stops and stations.

– People with disabilities experience physical, sensory, or mental impairments that significantly restrict one or more major life activities. In terms of transport, individuals with disabilities are those for whom using conventional public transport would be impractical or cause significant difficulties (TCRP, 2013). Pedestrians with disabilities face challenges when reaching public transport stops or stations due to physical barriers. These barriers may include inadequately sized sidewalks, poorly maintained footpaths, steep inclines, difficult crossings, and a lack of benches and lighting. Such obstacles can significantly hinder individuals with physical impairments, particularly those who rely on walkers or wheelchairs, and those with visual impairments, increasing the risk of falling. Additionally, these challenges can become more pronounced when the distances to be covered are long (Park & Chowdhury, 2022). People with disabilities often encounter several challenges when using public transport facilities. These challenges include a lack of shelters at bus or train stops, insufficient lighting, safety concerns in waiting areas, and the inaccessibility of vehicles. Additionally, improper installation and arrangement of amenities at stops and stations may obstruct the designated space for lifts or ramps, further deteriorating the mobility of wheelchair users (TCRP, 2013). Uneven platform-vehicle gaps and lack of level boarding can create difficulties for those with physical and visual

impairments (TCRP, 2013). People with disabilities may feel vulnerable and unable to protect themselves, and, therefore, they prefer waiting and in-vehicle travel times to be minimized (Park & Chowdhury, 2022). Individuals with disabilities often report experiencing bullying, intimidation, verbal abuse, and hostile interactions on public transport, viewing these acts as discrimination and stigmatization (Wayland et al., 2022).

3. MYSTERY SHOPPING SURVEY TOOL

3.1 Concept

Mystery shopping is a marketing research method where trained individuals, referred to as "mystery shoppers," pretend to be regular customers and examine the practices of customers, sellers, and service providers (Voß et al., 2020). Their purpose is to evaluate service quality, ensure compliance with regulations, and observe employee behavior at a business. This technique is commonly used across various industries, including retail, hotels, banking, and healthcare, to monitor and enhance service quality (Mattsson, 2012; Tarantola et al., 2012; Sebova et al., 2021; Yaoyuneyong et al., 2018). Businesses use mystery shoppers' feedback to identify service delivery weaknesses, evaluate employee performance, and ensure compliance with company standards.

In public transport, mystery shopping surveys involve specially trained personnel who pose as regular passengers to conduct objective assessments. During these evaluations, they make detailed observations of service conditions based on specific standards. Auditors use predefined checklists to ensure consistency in QoS assessments across different evaluators. Conducting these surveys regularly helps identify fluctuations in QoS and allows for the examination of quality aspects that passengers may not fully perceive. Unlike customer satisfaction surveys, which typically take place during or immediately after a passenger's journey, mystery shopping surveys offer a more comprehensive and objective evaluation. This method reduces the likelihood of passengers forming inaccurate impressions of the level of delivered QoS.

The concept of mystery shopping in public transport has not been extensively examined in academic research. Only a limited number of studies are available, and many of them focus primarily on metro systems (Georgiadis et al., 2014; Lu et al., 2009; Sidorchuk et al., 2015; Voß et al., 2020; Voß & Ge, 2024; Wilson & Gutmann, 1998).

Georgiadis et al. (2014) proposed a performance measurement system for bus public transport services in Thessaloniki, Greece, to track the achievement of strategic objectives set by the local authority and address the main QoS criteria in public transport. Following the principles established in EN13816:2001 (CEN/TC 320, 2001), they created forms for customer satisfaction and mystery shopping surveys. They designed three calibrated checklists for the mystery shopping component to assess 16 QoS indicators at bus stops, onboard conditions, and ticket sales points. The mystery shopping tools enabled the evaluation of various elements, including the accessibility for passengers during boarding and alighting, staff assistance, availability of safety equipment, and the conditions of park and ride facilities, among others. In the metro public transport network of London, UK, the aim of the mystery shopping survey was twofold. The first objective was to promote public transport as a more attractive option compared to the car, while the second was concerned with the continuous improvement of services and the satisfaction of current and future users. Mystery shoppers were given checklists to record their experiences in stops by considering the following QoS factors: Cleanliness and environment, Brightness, Short-term information, Long-term information, Electronic information, Comfort factors, User facilities, Ticket purchase, Staff, User access and mobility (Wilson & Gutmann, 1998). In New York, USA, 68 indicators across four categories were evaluated through mystery shopping surveys in subway cars, subway stations, local buses, and express buses, highlighting various aspects of service quality and passenger experience (Lu et al., 2009).

In recent years, there has been a growing focus on the requirements of mobility-restricted and vulnerable passengers in public transport, aligning with global strategic objectives to promote equal participation of all demographic groups in social and economic activities (UN, 2021). Current studies utilizing mystery shopping surveys concentrate on public transport stops and seek to address the needs of vulnerable users by combining traditional methods with modern technologies. Voß et al. (2020) conducted a study that evaluated bus station design using mystery shopping techniques. They found that incorporating various technologies—including Augmented Reality, Virtual Reality, and Mystery Shopping—can yield new insights regarding the relationship between public transport users and the transport system itself. This methodology particularly considers diverse user groups, such as older adults, people with disabilities, young children, and pregnant women, who may utilize public transport. In a more recent study, Voß and Ge (2024) examined the creation of a mobile app for passengers and transport agencies to assess public transport services from the viewpoint of wheelchair users, using the mystery shopping method. The app is designed to enhance the understanding of the needs and challenges encountered by this population group to develop more targeted solutions aimed at achieving a "completely barrier-free" public transport system.

While mystery shopping surveys are valuable tools, they do have limitations. One concern is the potential subjectivity of the mystery shoppers, which raises questions about whether their evaluations accurately reflect the experiences of real customers. Research indicates that the ratings given by mystery shoppers may not consistently align with actual customer satisfaction or sales performance. This raises concerns about relying solely on mystery shopping surveys as a measure of service quality (Blessing & Natter, 2019).

3.2 Addressing QoS criteria and vulnerable user needs

We linked each QoS criterion to a range of relevant quality assessments to construct the proposed mystery shopping checklist. These assessments' nature and specific content were designed with the unique needs of vulnerable users, as highlighted in the research findings reviewed in Section 2.3. The main objective of these quality assessments is to allow vulnerable individuals to access and utilize bus public transport stops in an environment free of barriers. Establishing a barrier-free setting is crucial for those with limited mobility, but all users benefit from barrier-free mobility's safety, comfort, and independence (Maynard, 2009). Based on earlier studies (Voß & Ge, 2024), we identify the following key planning-related factors for barrier-free travel, specifically concerning public transport stops, and we have developed pertinent quality assessments:

– Walking to and from the bus stop: In this aspect, we evaluate the availability of adequately sized (> 1.5m) sidewalks and ramps for people with mobility restrictions. We check for any pavement damage that may impede pedestrian flow and identify obstacles such as micromobility vehicles or temporary and permanent constructions that could restrict the space available for accessing and waiting at the bus stop. Additionally, we consider stops in areas without pavement, assessing whether a concrete platform has been constructed for the waiting area and whether any unfavorable conditions exist, such as vegetation, obstacles

that reduce visibility, or high speeds of passing vehicles. We also examine the distance between bus stops and the nearest built-up area.

– Waiting at the bus stop: Here, we assess the quality of the waiting area by examining the condition of shelters, checking for vandalism near the infrastructure, ensuring cleanliness, and evaluating lighting. We also verify information sources' presence, condition, and accuracy, and observe passenger behavior.

– Getting on and off the bus: In this aspect, we focus on whether the bus can stop close enough to the curb to allow passengers to enter and exit the vehicle smoothly. We also consider overcrowding during boarding and alighting, as this can negatively impact the experience for vulnerable passengers.

Table 1 illustrates this process flow and showcases the systematic approach employed. For each QoS criterion, we have developed relevant Mystery Shopping quality assessments that address vulnerable users' concerns, summarized in the last column. In total, we have created 15 distinct groups of quality assessments. For instance, there are 3 groups of quality assessments for the QoS criterion related to "Availability":

1. Stop Sidewalk: This assessment evaluates the size of the sidewalk, the presence of ramps for wheelchair accessibility, the condition of the pavement, and any obstructions, such as barriers, that could restrict the waiting area.

2. Stops Without Sidewalks: This assessment examines whether the waiting area has a reinforced concrete base, whether dense or tall vegetation may limit walking and waiting space, and any obstacles that could reduce vis-

ibility, particularly when combined with high-speed traffic.

3. Area Coverage: This assessment considers the distance from the nearest bus stop and built-up areas.

3.3 Development and validation of the mystery shopping tool

The measurement tool to facilitate these assessments took the form of a structured checklist, which provided detailed instructions and guidance for carrying out each quality assessment. Each quality check is articulated as a question presented in one of two formats, which surveyors are tasked with answering. The first format is the closed-ended format, wherein mystery shoppers must confirm the presence of a specific object or facility by responding with a simple "yes" or "no." The second format, i.e. scale format, requires mystery shoppers to evaluate the facilities or objects they examine using a 5-point scale. Each rating on this scale corresponds to a predefined level of quality, with 1 always being the comparative worst and 5 the comparatively best level of QoS delivered. For instance, we included one closed-ended question alongside two scale-based evaluations in assessing the shelters at bus stops. The surveyors were first asked a closed-ended question regarding the availability of shelter, requiring a "yes" or "no" response. Subsequently, they were asked to rate the stability of the shelter and the degree of vandalism evident on its frame. The scale used for these latter questions ranged from 1 to 5, with a rating of 1 indicating a "dangerous situation" or "significant vandalism." In contrast, a rating of 5 represented an "excellent condition" and an "absence of vandalism".

The choice to use both closed-ended and scaled questions was influenced by the possibility that certain features might

QoS Criteria	Indicative Mystery shopping quality assessments	Total number of quality assessment groups	Vulnerable users' concerns
Availability	Distance (meters) from the nearest bus stop or built-up area; Ramps for entering/ exiting sidewalks;	3	Long walking distances can discourage people from using the bus due to slower walking speeds and physical limitations. Mobility-impaired or visually impaired passengers require an obstacle-free access route to reach the bus stops.
Accessibility	The proximity of the bus which stops at the boarding/ alighting point; Condition of pavements	4	Individuals who experience mobility impairments and older adults often face significant challenges when navigating the vertical transitions between the curb and the entrance or exit of a bus. The physical effort required to manage these movements can lead to increased anxiety and discomfort, potentially deterring them from using public transport.
Information	Existence; Variety; Condition, and Validity of printed information material at bus stops	3	The availability of information sources at bus stops can assist vulnerable users in orienting themselves and estimating waiting times, thereby enhancing their overall travel experience and reducing anxiety while waiting for the bus.
Time	Crowding events during boarding/alighting; Existence and proper operation of real-time information screens.	5	Excessive travel times can impact vulnerable individuals with limited physical abilities or those carrying loads. Waiting at bus stops and delays during boarding/alighting can be challenging, as even brief moments of standing can feel exhausting and stressful, making the journey uncomfortable.
Customer care	Existence; Condition; and Validity of contact details with public transport operator.	3	Physical assistance or updated information has to be obtained mainly during service disruptions or unexpected events and delays.
Comfort	Cleanliness and comfort of bus stop environment; Existence and Condition of shelter and seating areas for waiting	4	Public transport stops should offer adequate shelter from various weather conditions, protecting individuals from rain, wind, and harsh sunlight. Additionally, they should include seating options to accommodate those with limited physical abilities or carrying heavy loads, allowing them to rest while waiting for the bus.
Security	Lighting; Behavior of fellow passengers; Road safety conditions	4	Safety concerns are more critical among vulnerable users. These might be associated with higher protection needs against crime (violence, unwanted advances) and against the event of a road accident.

Table 1. QoS criteria, associated mystery shopping quality assessments, and their relevance to the needs of vulnerable users.

be absent at some bus stops, such as litter bins, shelters, pavements, and information sources. Additionally, some factors are difficult to evaluate using a 5-point scale, including passenger behavior, the correctness of information sources, and the accessibility of entry and exit ramps on the pavements. When possible, we employed a 5-point Likert scale to evaluate the facilities at public transport bus stops, concentrating on aspects such as cleanliness, lighting, and the distance from the bus to the boarding area. This approach aimed to standardize the ratings of the bus stops, at least concerning some of their features.

To finalize the mystery shopping survey form, we implemented a pilot study to determine the most effective phrases for the quality assessments, ensuring they could be conducted objectively by the surveyors, and to identify any other factors influencing delivered quality that were not initially part of the mystery shopping checklist. The field survey to test the mystery shopping survey tool took place within Thessaloniki's bus public transport network in May 2024.

Thessaloniki is the second-largest metropolitan area in Greece, with almost one million residents and a high population density. The public transport system is structured radially and has more than 70 fixed urban and suburban routes. Recent studies have indicated very low passenger satisfaction levels concerning various factors, including safety at bus stops, the availability of information at those locations, overcrowding, and comfort during boarding and alighting (Georgiadis et al., 2025).

The pilot application of the mystery shopping survey focused on evaluating 46 bus stops along a single route that links a suburban area of Thessaloniki with the city center. This strategy enabled an evaluation of both central and outlying bus stop locations. Researchers selected for the pilot study underwent the same training to ensure they could carry out the intended quality checks and consistently measure their observations. Completing the mystery shopping checklists required between 5 and 10 minutes at each bus stop.

The most important improvements to the survey tool focused on the bus stops situated in the suburban areas. In this evaluation, we observed several issues, such as the lack of pavement, insufficient protection from road traffic, poor shelter conditions, and obstacles like overgrown vegetation that obstructed access and comfort for waiting passengers (Figure 1). As a result, relevant modifications were made to enhance the proposed mystery shopping tool. The finalized mystery shopping survey checklist for bus stops can be found in the Appendix.

4. DISCUSSION AND CONCLUSION

The population of vulnerable individuals is projected to grow significantly in the coming years, particularly as women tend to outnumber men in older age groups. By 2050, it is anticipated that the proportion of the population aged 65 and older in Europe will rise from 21% to 30%, highlighting a substantial demographic shift. Additionally, the global population aged 80 and above is experiencing rapid growth due to increased life expectancy and advancements in healthcare. Furthermore, approximately 16% of the world's population currently experiences some form of disability, a figure that could rise as the global population ages (UN, 2021). Enhancing public transport systems to meet better the needs of women, older adults, and individuals with disabilities is crucial. Research shows that women often choose less expensive transport options due to financial constraints and frequently rely on public transport, with many lacking a driver's license or private vehicle. This highlights the need for safer, more accessible public transport tailored for women. Addressing safety, service frequency, and accessibility in public transport can reduce women's mobility barriers in accessing jobs and essential services. By improving transport with women's needs in mind, we enhance their commutes and support gender mainstreaming initiatives, empowering women and promoting equal access to essential resources for their social and economic participation (Campisi et al., 2022). Many older adults face challenges in engaging with society because they face problems using public transport systems, specifically regarding accessibility conditions. Health-related problems might hinder their ability to drive, leading to decreased participation in outdoor activities and a decline in their overall quality of life. Ensuring that public transport is accessible and inclusive can assist older adults in maintaining their social connections, reducing feelings of loneliness, and gaining independent mobility (Li et al., 2012; Sundling, 2015). Individuals with disabilities tend to travel less often and depend more on public transport compared to the general population. When they cannot utilize public transport, they may experience isolation, loss of independence, and difficulty engaging in socio-economic activities (Park & Chowdhury, 2022; Wayland et al., 2022). Inclusive, human-centered, and appealing public transport systems can restore passengers' trust after the significant decline in demand due to the COVID-19 pandemic and encourage the participation of vulnerable individuals in social and economic activities.

Figure 1. Examples of bus public transport stops in the suburban districts of the survey area

In this paper, we have emphasized the QoS factors that impact passenger waiting conditions at bus stops, which often play a crucial role in selecting public transport as a travel mode. We outlined the QoS criteria relevant to bus stops and described methods for measuring quality according to established public transport standards. In alignment with the recent strategic goals of the UN 2030 Agenda, which aims to create inclusive public transport that provides accessible and comfortable services for vulnerable users—including women, older adults, and people with disabilities—we linked each QoS factor at bus stops to specific quality assessment measures. Furthermore, we developed a mystery shopping survey tool in the form of a structured checklist. This checklist consists of 15 groups of QoS assessments accompanied by clear instructions for conducting relevant audits by trained researchers. The format and content of the mystery shopping checklist make it a practical tool for evaluating QoS at bus stops. It also allows for the documented identification of service weaknesses, enabling the rational prioritization of investments to enhance service levels in public transport, especially for integrating vulnerable groups within the population.

ACKNOWLEDGEMENTS

APPENDIX A. MYSTERY SHOPPING SURVEY CHECKLIST FOR BUS STOPS

1. Stability risk of the shelter and other individual parts	Comfort/ Security	
Mark X if there is no standing frame and continue with question 4.		
Assessment of the overall condition and the appearance of maintenance and stability presented by the shelter, the seating options, the advertising frame, and the other individual components of the shelter's frame.		
Dangerous situation/Brink of collapse	1	
Absence of individual sections/Limited stability	2	
Moderate condition	3	
Good condition	4	
Excellent condition	5	
2. Existence of graffiti and other vandalism	**Comfort**	
Unauthorized posters and stickers are checked for in all parts of the structure (advertising frame, seating areas, etc.). Vandalism is considered intentional damage (e.g., broken windows, etc.) and not due to poor maintenance.		
Significantly vandalized or covered with graffiti, posters, and stickers	1	
Moderately vandalized or covered with graffiti, posters, and stickers	2	
Minimal vandalism or minimal graffiti, posters, and stickers	3	
Almost no vandalism or graffiti	4	
Absence of graffiti, vandalism, posters, and stickers	5	
3. Cleanliness	**Comfort**	
*Cleanliness conditions on the surfaces of the structure (seating areas, shelter's posts, advertising frames, etc.) are checked, and not any waste or graffiti and stickers.		
Very dirty	1	
Dirty	2	
Clean with a few dirty spots	3	
Almost clean	4	
Spotlessly clean	5	
4. Litter at the stop and in the area around the stop	**Comfort**	
Is there a trash can near the stop?	**YES**	**NO**
Lots of trash/ Passengers stand among them	1	
Much garbage concentrated in certain places	2	
Lots of small waste	3	
Minimum amount of small waste	4	
Absence of waste	5	
5. Lighting at the stop and in the area around the stop (radius of 5m to effectively cover the surface of the waiting area)	**Security**	
Mark X if the check was done on the day and proceed to question 6		
*Lighting conditions at the stop are controlled by public adjacent lighting poles or lighting devices placed at the stop - Illuminated advertising panels are also considered lighting sources.		
Minimal lighting / Almost dark	1	
Little or dim lighting/Light bulbs do not operate at sufficient intensity	2	

Adequate lighting/ Lamps work satisfactorily	3
Good lighting at the stop and in the area near the stop	4
Perfect lighting	5

6. Existence of printed or written information	**Information/ Time/ Customer Care**
The existence of printed and written information sources at the stops is checked, not any damage or alterations and inaccuracies that may include	
Mark with √ which of the following sources of printed and/or written information did you notice at the stops?	
a. Stop name	
b. Stop code	
c. Bus lines passing through the stop	
d. Map of the area (depicting roads, important points)	
e. Lines' maps	
f. Route schedules - posted written form	
g. Information on pricing policy	
h. Information on access for people with disabilities.	
i. Phone number/website link to contact the system administrator	
j. Other info	

7. Condition of printed and/or written information	**Information/ Time/ Customer Care**
Please mark with √ which of the following sources of printed or written information you observed at the stops have not suffered significant damage, and passengers can read them to their full extent.	
a. Stop name	
b. Stop code	
c. Bus lines passing through the stop	
d. Map of the area (depicting roads, important points)	
e. Lines' maps	
f. Route schedules - posted written form	
g. Information on pricing policy	
h. Information on access for people with disabilities.	
i. Phone number/website link to contact the system administrator	
j. Other info	

8. Validity/Correctness of printed or written information	**Information/ Time/ Customer Care**
The accuracy of the identified printed and written information sources is checked. For route maps and timetables, up to 3 lines should be checked (preferably those with high frequency and/or long route length)	
Mark with √ which of the following forms of printed or written information that you observed at the stops are accurate	
a. Stop name	
b. Stop code	
c. Bus lines passing through the stop	
d. Map of the area (depicting roads, important points)	
e. Lines' maps	
f. Route schedules - posted written form	
g. Information on pricing policy	
h. Information on access for people with disabilities.	
i. Phone number/website link to contact the system administrator	
j. Other info	

9. Real-time information screens	**Information/ Time**	
Mark X if there was no information screen at the stop and continue to question 10.		
The condition of the real-time information screens is checked, and not the validity of their indications		
Absence of significant damage to the installation	**YES**	**NO**
The screen was on.	**YES**	**NO**
The screen displays were easy to read	**YES**	**NO**

10A. Stop sidewalk	Availability/ Accessibility	
Mark X if the stop is not on a sidewalk and answer question 11B.		
The sidewalk has an adequate width (>=1.5 m.) across the block.	YES	NO
There are adequately sized ramps for wheelchair entry/exit on the sidewalk.	YES	NO
Absence of significant damage to the pavement that impedes traffic	YES	NO
Parked vehicles, constructions, and other illegal acts/events do not restrict the available waiting area for passengers.	YES	NO
10B. Stop located in a place without a sidewalk	Availability/ Accessibility/ Security	
Is there a reinforced concrete base for the station to be installed for waiting passengers?	YES	NO
Please mark with √ which of the following unfavorable conditions for passenger access and waiting you observed at the stop.		
a. Dense and/or tall vegetation		
b. Reduced visibility of the stop due to obstacles (e.g., trees, parked vehicles, etc.)		
c. High speeds of passing vehicles		
11. Passenger access to/from the bus	Accessibility/ Time	
The access conditions of passengers to/from the buses passing through the stop under examination are checked.		
The bus approached the stop easily without being obstructed by other parked vehicles (except buses)	YES	NO
No overcrowding was observed during passenger boarding/alighting due to passengers boarding/alighting on other buses.	YES	NO
12. Distance of bus parking from the stop	Accessibility	
The proximity of bus stops to the stops is controlled. Buses must be parked at such a distance from the stop that passengers do not have to walk far to get to/from the bus to/from the stop. This specific condition significantly affects the accessibility of people with mobility impairments.		
Passengers need to walk to board/disembark the bus from/to the stop	1	
Not satisfactory bus proximity to the stop	2	
Satisfactory proximity, but not precisely at the stop	3	
Almost good proximity	4	
Good approach to the stop or as close to the sidewalk as possible	5	
13. Passengers' behavior	Security	
Checking for unacceptable behavior and actions by passengers waiting at the stop		
Dangerous/threatening behavior towards a passenger (e.g., verbal/physical violence)	YES	NO
Anti-social behavior (e.g., noisy people, loud music, littering)	YES	NO
14. Area covered	Availability	
This distance is measured on-site, considering the available sidewalks. A direct and barrier-free sidewalk should be used to measure the distance to bus stops and built-up areas. Distance measurement should start from the point where the bus pole is installed. The beginning of a built-up area is marked by the first appearance of permanent structures, such as houses, commercial buildings, and warehouses that are occupied or in use.		
The walking distance to the nearest bus stop is less than 500m.	YES	NO
The walking distance to the nearest built-up area is less than 500m.	YES	NO

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