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# IMPROVING THE MANAGEMENT OF PUBLIC TRANSPORT IN LITHUANIA'S MAJOR CITIES IN THE CONTEXT OF SUSTAINABLE MOBILITY AND MULTIMODALITY

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## Abstract

*This paper analyses the problems of passenger transport management in the context of sustainable mobility and multimodality in major Lithuanian cities. The urban transport system, development, and problem areas in meeting consumer needs are discussed. The article also discusses the ways to promote the use of public transport services in sustainable mobility and multimodality by solving the problem areas of passenger transport management. The article analyses the attitude of residents of major Lithuanian cities towards the importance of sustainable mobility and multimodality. The factors that determine the decision of the inhabitants of the major Lithuanian cities to use sustainable mobility and multimodality are presented, and ways to improve the quality in this area are considered.*

*A quantitative method is applied to study the previously described attitudes and confirm the hypothesis that there are specific management difficulties related to sustainable mobility and multimodality. According to the study, most residents of Vilnius and other major cities do not combine public transport with other modes. Only less than one-third of survey participants combine multiple modes of transport on their trips. Implementing public transport management solutions in the context of sustainable mobility and multimodality should become a model.*

**Keywords:** *passenger transport management, passenger transportation, sustainable mobility and multimodality, public transport services, evaluation indicators*

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## 1. INTRODUCTION

Transportation is a strategically important sector that directly contributes to production, mobility in society, meeting daily needs, and territorial division of labor. Road transport, especially in urban areas, is still the primary mode of transport for passenger and freight traffic, creating additional problems. Recently, ways have been developed to make the transport system more efficient. In this way, it would be possible to increase the synergies between the different modes of transport and make the best use of each of them, which would improve connectivity, ensure higher quality and safety of transport services, and reduce the ever-increasing pollution in the transport sector. As urbanization continues and the urban transportation system becomes increasingly congested, road users lose time to congestion, traffic-related pollution increases, and economic efficiency is lost. Various measures are being taken to improve the urban transport system. Still, there is a lack of effective collaborative solutions in the context of sustainable mobility and multimodality that can make a real difference and provide long-term benefits in addressing the growing problems in the urban transport system (Jaržemskis & Jaržemskis, 2017). The essential goal of the urban transportation system is to ensure complete freedom of mobility and high-quality provision of goods and services, combining the aspects of time, convenience, safety, environmental friendliness, and financial efficiency (Ibrahim, 2018). If the system is to function smoothly while satisfying communication and the needs of all road users and vehicles, it is necessary to study problem areas and adapt the necessary proposals in an integrated way (Pronello & Camusso, 2017).

The following research questions are specified in this paper:

- How is the public transport system in major Lithuanian cities managed in the context of sustainable mobility and multimodality?
- Which management solutions would ensure the development of sustainable mobility and multimodality in the provision of public transport services in major Lithuanian cities?

The resulting hypothesis is related to the difficulties of public transport in terms of sustainable mobility and multimodality in major Lithuanian cities.

The research aims to predict and design solutions for problematic areas of passenger transport management related to sustainable mobility and multimodality in major Lithuanian cities.

The research objectives are as follows:

- Completing a scientific and methodological literature review to identify relevant prerequisites for applying sustainable mobility and multimodality.
- Identifying problem areas in managing public transport services in the context of sustainable mobility and multimodality in major Lithuanian cities.
- Evaluate the changes implemented in the field of public transport cleaning in the context of sustainable mobility and multimodality.
- Identify ways to manage the quality of public transport services by developing sustainable mobility and multimodality.

The article analyses the literature identifying common problem areas related to traffic congestion, road safety, and sustainable transport presents a theoretical model of the impact of sustainable mobility and multimodality on passenger transport management, analyses the areas of sustainable mobility and multimodality in major Lithuanian cities, and an integrated governance model promoting sustainable consumer mobility and intermodality.

The presented research results on improving public transport management in the context of sustainable mobility and multimodality may well be applied in other European countries. According to the Common Policy, the main objective is to ensure open markets between member states by gaining a competitive advantage over other regions. Another critical aspect of the Common Transport Policy is to address relevant problems in the transport sector, make proposals, and develop visions and strategies for the future. EU transport policy guidelines are implemented in the transport systems of individual member states, considering the specifics of proposed or required changes in legislation. The primary transport policy documents and requirements for member states highlight the challenges associated with multimodal, sustainable, and optimally functioning public transport in cities. The documentation also includes proposals for improving problem areas in cities. These suggestions are usually based on the strategic goals of foreign countries. They may include promoting a shared mobility system, increasing taxes and bans on polluting transport, investing in infrastructure and innovative technological solutions, raising public awareness, and changing harmful travel habits by promoting sustainable mobility and multimodality. Existing research can be further developed by applying methods of statistical data

analysis and qualitative research to study sustainable mobility and multimodality approaches in major Lithuanian and foreign cities.

## 2. LITERATURE REVIEW

The fundamental objective of the urban transportation system is to provide complete freedom of movement and quality of goods and services by combining aspects such as time, convenience, safety, environmental friendliness, and financial efficiency. The system is considered functional when all road users' and vehicles' communication and service requirements are met. To achieve such a result, it is necessary to study problem areas and implement the necessary proposals in a complex way (Jarašūnienė & Česnulaitis, 2021).

Recent studies have determined which management forms are most cost-effective in providing local public services. The management of the city's public transport is an important area of urban life whose objective is to satisfy the users' needs for passenger transport in a punctual, high-quality, and complete manner (Campos-Alba et al., 2020). The quality of public passenger transport services can significantly impact road safety. Improving the quality of passenger transport is one of the most critical areas of urban transport system development (Bashynska et al., 2020).

In addressing the challenges of sustainable mobility and multimodality, it is essential to focus on how to make the best use of each transport mode and increase synergies between them to improve connectivity, ensure higher quality and safety of transport services, and reduce pollution (Batarlienė & Jarašūnienė, 2021). Transport based on sustainable mobility

and multimodality is a wide-ranging issue affecting social, economic, and ecological environments. Sustainable mobility and multimodality contribute to sustainability in the transport sector. They are measured by the efficiency of the transport system, which depends on many factors: vehicles used, their sources, intermodality, transport infrastructure, operational and logistical solutions, existing mobility and accessibility options, and future long-term strategies. Combining all these factors into a sustainable, constantly evolving, sustainable and social, economic, and environmental welfare system is understood as transport based on sustainable mobility (Stojic et al., 2020).

Combining different modes of transport, creating convenience and a basis for their use can increase the impact of sustainable transport and the efficiency of the whole transport system (Singal, 2018; Macioszek & Kurek, 2020). There are two ways to improve multimodality in the city - by improving the accessibility and quality of public transport and by creating the proper infrastructure for non-motorized transport, especially in central regions (Singal, 2018).

Identifying the general problem areas related to traffic congestion, road safety, and sustainable transportation. The problem of *traffic congestion* on the roads of major Lithuanian cities and suburban highways is very relevant. Kumarage (2004) argues that traffic jams are problematic for many people because they disrupt their schedules. Congestion wastes time, which is perceived as an economic value. Kumarage's (2004) article explores whether traffic congestion is something we have to learn to live with or if initiatives can be taken to reduce it and keep it to an acceptable level. Jain, Sharma & Subramanian (2012) mention that traffic congestion is a significant problem in most regions of the developing world. Venkataya,

Pudaruth, Dirpal & Narain (2018) consider that congestion in India is mainly due to poor road conditions, various road features, poor lane discipline, inadequate location and design of bus stops, diversity of traffic and unrestricted on-street parking. Ali & Faraj (2013) mention that the congestion problem is a common problem between developed and underdeveloped countries, so it is a global problem. Nguyen-Phuoc, Young, Currie & De Gruyter (2020) mentioned that traffic congestion reflects the differences in traffic conditions when the traffic is heavy and when the road is easily passable. Thresholds were introduced to determine the degree of traffic congestion on a roadway or in an area.

Concerning *road safety*, Urciuoli & Sternberg (2002) pointed out that ensuring security in transportation networks is essential to maintaining the integrity of freight transported around the world to avoid disruption, anxiety, and confusion in our communities. Szczukowski (2017) points out that security or safety are content-specific expectations in psychological terms and for society. Joewono & Kubota (2006) consider that safety class consists of three aspects. Savage (2001) mentioned that transportation has always been associated with the risk of death, injury, and destruction of property. According to Savage (2001), risk settings may change over time. Innovative technologies such as navigation systems and new materials have allowed companies to provide more safety at lower or comparable costs than was previously possible. The risk of road accidents is high in developing countries because society's limited resources mean it has other priorities, such as providing primary education and healthcare. Growing prosperity and product innovations are, therefore, always a good sign for reducing traffic risk.

Regarding road safety, estimating the number of people injured and killed in traffic

accidents is essential. Table 1 shows the number of people injured and killed in road accidents in Lithuania in 2016-2020. According to the statistical data, the number of injured people in 2016 was 3749, and already in 2020, the number of injured people decreased to 3271. Looking at the number of injured people by county, the highest number in 2019 was in Vilnius County, where the number of injured people reached

1002. The lowest number of injured people in 2016 was in Panevėžys county.

The data presented in Table 1 show that the highest number of fatalities in 2016-2020 was in Vilnius County. In 2018, the number of fatalities was 58 people. The lowest number of deaths is recorded in Šiauliai, Panevėžys, and Klaipėda counties.

**Table 1.** Number of people injured and killed in road traffic accidents in Lithuania

		Number of people injured and killed in road accidents				
		2016	2017	2018	2019	2020
<b>Injured</b>	Republic of Lithuania	3749	3561	3390	3782	3271
	Vilnius county	903	960	921	1002	...
	Kaunas county	883	758	701	835	...
	Klaipėda county	521	547	408	473	...
	Panevėžys county	327	335	338	387	...
	Šiauliai county	413	308	325	335	...
<b>Dead</b>	Republic of Lithuania	192	191	173	186	175
	Vilnius county	47	43	58	50	...
	Kaunas county	39	40	34	36	...
	Klaipėda county	14	18	20	21	...
	Panevėžys county	29	20	15	20	...
	Šiauliai county	17	17	17	13	...

Source: Lithuanian Department of Statistics (2021).

Ogryzek, Kmiec & Klimach (2020) pointed out that in the field of transport, not only should technical and superficial aspects be considered, but the focus should be on people's expectations and optimal solutions, taking into account sustainability. The essential feature in planning is traffic safety, especially for cyclists and pedestrians. Safe infrastructure must be created for these modes of transport, i.e., physical separation of people from the road space and, if that is not possible, from the car's speed. Traffic education must be provided from an early age.

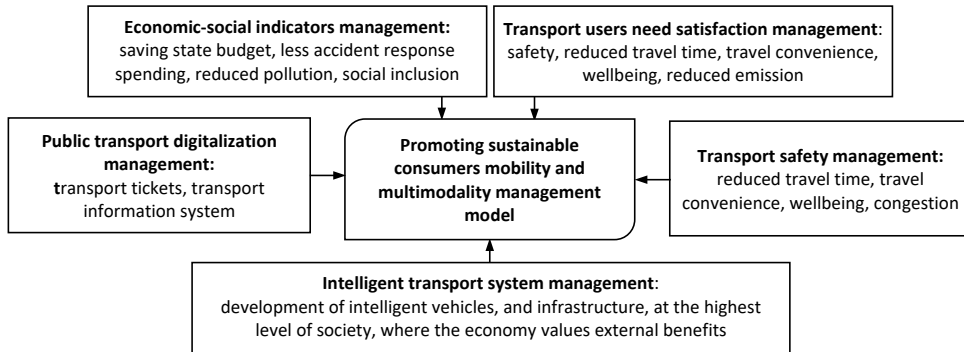
Concerning *sustainable transportation*, Steg (2006) mentions that various behavioral changes can contribute to sustainable transport. Pujiati, Nihayah, Adzim & Nikensari (2020) and Brotodewo (2010) point out that sustainable transport means a transport system with no adverse impacts on fuel consumption, vehicle emissions, safety, congestion, and socioeconomic access.

## 2.1. Impact of sustainable mobility and multimodality on passenger transport management

According to Grotenhuis, Wiegmans & Rietveld (2007), many cities face significant traffic problems resulting in congestion, pollution, noise, and an increased number of accidents. One of the measures to reduce the inconvenience of congested roads is to promote public transport. Therefore, local authorities and the government are trying to convince people to switch from private cars to public transportation. One of the factors affecting the quality of public transportation is travel information. Providing information alone cannot persuade people to switch, although this service has been identified as necessary in various studies and thus can contribute significantly to the overall quality of public transportation (Kusdibyó & Februadi, 2019; Giannoutakis & Li, 2011). Solotruk & Kristofic (1980) identify the components: “methods,” “activities,” “techniques,” “data,” and “people” that make up the basic structure of an information system. “Methods” refer to the organization and its activities. “Activities” are public transportation trips for which information was needed. “Technology” refers to how travel information is provided, i.e., the systems used to provide information. “Data” can be considered the type of travel information provided. The “people” component usually refers to the customer and other participants in the information system. Herrador, Carvalho & Feito (2015) mentioned that a conceptual model for a sustainable mobility business should require a wide range of economic and environmental indicators. Therefore, the socioeconomic impacts of transport should be taken seriously, as they are crucial for people’s quality of life. Herrador, Carvalho & Feito (2015) argue that public financing is well-suited for sustainable transport

business models. The authors believe that the most effective way to reduce congestion and keep the air clean is for people to share trips. Conticelli, Gobbi, Rosas & Tondelli (2021) identified nine main areas that describe sharing: accessibility, quality of exchange environment, security and safety, exchange efficiency, exchange planning, service information, service coordination, initiatives to change citizens’ behavior, policies, norms, and regulations. These areas can have different impacts at the policy and project levels.

Based on the analysis of the scientific literature, a theoretical model for the promotion of sustainable mobility and multimodality of consumer management is presented in Figure 1. It includes indicators such as economic-social environment, transport user satisfaction, digitalization of public transport, and intelligent transport systems. All these indicators contribute to developing a model for promoting sustainable mobility and multimodality for consumers.



**Figure 1.** The theoretical model for promoting consumers' sustainable mobility and multimodality management

The European Commission (2020) mentioned that greener mobility must be based on an efficient and interconnected intermodal transport system for both passengers and freight, an improved accessible high-speed rail network, refueling infrastructure for high-polluting vehicles, and increased use of renewable and low-carbon fuels through cleaner technologies in greener cities, contributing to the health and well-being of citizens. Europe must also use digitalization further to increase safety, reliability, and comfort levels to maintain leadership in transport services and improve its global competitiveness through efficient and resilient logistics chains.

Ogryzek, Adamska-Kmie & Klimach (2020) describe the principles and guides of sustainable transport that can steer cities toward a more efficient transport network. The authors considered components such as public transport indicators, car use, and the number of cycling and walking trips. In addition, solutions such as the common space, the development of cycle paths and public transport networks, the separation of different modes of transport, the reduction of distance and the need to travel, and policy changes have proposed technological innovations. Ranceva & Ušpalytė-Vitkūnienė (2021) note that positive changes in public

transport are possible if the process involves not only state and municipal institutions but also infrastructure planners, passenger carriers, and residents themselves. In their article, Makarova, Pashkevich & Shubenkova (2017) present the possibility of improving the sustainability of the urban public transport system by implementing a control management system. The proposed method was tested on the sample of Naberezhnye Chelny. The interaction scheme of the program modules of the conceptual system model is also presented. A composite indicator was proposed to evaluate the effectiveness of the system. The information logical data model and the process of scientific decision-making in the urban space on the public transport route are described.

In Vilnius, the capital of Lithuania, the necessary infrastructure is improving, and the population's habits are also changing. Some companies are also applying best practice policies. According to SĮ "Susisiekimo paslaugos" (2019), managers decided to motivate employees by paying for public transport tickets a few years ago. The company has been buying Vilnius cards and regularly replenishing them for a few years. This way, employees can comfortably get to work using public transport and

the city's bicycles. This corporate initiative has grown into a support for the idea of sustainable mobility. Šl "Susisiekimo paslaugos" (2019) notes that Arimex's connection to sustainable mobility was driven by a desire to live an active, healthy and harmonious life. "For us, it is a part of life, so we are happy to take every opportunity to set an example for ourselves and others that it all starts with small steps," said Jukna, Director of Arimex.

The company's employees opted for cycling to and from work to maintain physical activity. "In 2019, employees biked 14,407 kilometers to and from work. Promoting sustainable mobility is not an artificial desire to get a person out of a car when they really need it, but a call to think about alternatives that really exist, to try them out, to discover what is now convenient, fastest," said the Head of Communication at Transport Services. In Vilnius, as in many other foreign capitals and cities, multimodality is promoted. The goal is to create conditions that combine as many travel options as possible - investing in walking trips, actively improving bicycle and pedestrian infrastructure, and building new bicycle and pedestrian paths. As infrastructure improves, the mobility habits of the capital's population change. People often ride scooters or bicycles to work or sports clubs instead of driving, and in the evening, they walk instead of going to the city center. Over 50 km of bike lanes in the last four years have been built and renovated in Vilnius, and another 20 km of connections are planned for next year. Other forms of sustainable mobility are also being introduced, such as electric scooter-sharing services, education about the benefits of sustainable mobility, and fun campaigns inviting people to try alternative modes of transport to cars. As of October 2019, there

are already four "Build and Drive" locations in the capital.

### 3. RESEARCH METHODS

A quantitative research method was used to analyze the status of sustainable mobility and multimodality in major Lithuanian cities and define their problem areas and management opportunities. This data collection method allowed for interviewing more respondents in a shorter time. The questionnaire was developed following the theoretical findings and the distinguishing criteria found in the literature. The questionnaire contains open and closed questions, which allow for an investigation of sustainable mobility and multimodality in major Lithuanian cities. In addition, the questionnaire made it possible to identify the strengths and areas for improvement and define the causes that prevent the implementation of multimodality.

Since sustainable mobility and multimodality include aspects of more convenient, safer, environmentally friendly, and faster movement in the city through the combination of transport modes and means, the research tool - the questionnaire - consisted of the following groups of questions: *respondents' attitudes toward combined travel; personal experiences using public transportation and combining multiple modes and types of transportation* (for example, car + public transport, bicycle, scooter; public transport + walking, bicycle and the like); *traveling methods in central parts of the city*, etc. The questions in this group are formulated so that one can choose the answers from the offered options.

To define *the problem areas in developing sustainable mobility and multimodality in major Lithuanian cities*, the questionnaire contained statements with five-point



answers on the Likert scale from “very often” to “I have not encountered.” In defining the problem areas in managing public transport services in the major cities of Lithuania, the aim was to review several constructs of this issue. For this purpose, principal component factors were analyzed using a Varimax rotation. The results show that the data are suitable for factor analysis:  $KMO = 0.941$  (not less than  $KMO = 0.6$ ), and the Bartlett Test specificity criterion  $p < 0.001$  indicates that the variables are not independent. After the rotation procedure, the factor analysis results show that the statements in question consist of weights of four factors ranging from 0.401 to 0.802. The first factor correlates with variables related to convenience and availability of the services provided (convenience and adherence to timetables, route network layout, speed of service provision, timetable information, changes to the website, and its adequacy and completeness). The second factor correlates with the variables reflecting the quality of the service provided (culture of public transport staff (drivers, inspectors) and treatment of passengers, professionalism). The third factor evaluates the quality of public transport (adequacy of public transport equipment, technical condition, ticketing and marking system, the physical safety of passengers, cleanliness and environmental friendliness of public transport) and the fourth factor reflects the adaptation of public transport to different user groups (adaptation of services for the disabled and parents with young children, discounts, discounts for schoolchildren, students, senior citizens, opportunities to transport pets, bicycles, scooters, etc.). Internal consistency was determined by calculating Cronbach’s alpha values for each statement group separately. The statistical analysis results show that the internal compatibility level (Cronbach’s alpha) for the use of public transportation in each of the selected

statement groups is relatively high, ranging from 0.8408 to 0.8846. Based on the fact that internal consistency should be between 0 and 1 and a Cronbach’s alpha of 0.60 is considered appropriate for research (Aiken, 2002). The Cronbach’s alpha calculated in this study indicates that the groups of statements should be considered harmonized.

The respondents were asked an open-ended question at the end of the questionnaire. The data obtained from the answers to the open question led to the application of the content analysis method. The collected data were analyzed by qualitative methods and grouped according to semantics, context frequency, the intensity of comments, and the criteria for the accuracy of answers.

Descriptive statistics were used to process the data collected during the study - absolute and percentage frequencies (percentages). The mean (M) and its standard deviation (SD) were used to describe the Likert scale variables, and the Students’t test was used to compare the means of the Likert scale variables in two independent samples. The chi-square criterion ( $\chi^2$ ) was calculated to determine the dependence of the relationships. The difference was considered statistically significant if the significance level was less than 0.05. Statistical analysis of the data was performed using SPSS version 17 software.

## 4. RESEARCH PROCESS AND RESPONDENTS

### 4.1. Survey sample

The sample consisted of 466 residents of major Lithuanian cities, of whom the vast majority were women (N = 359 (76.9%)), and only 107 (23%) were men. When analyzing the distribution of respondents by place of residence, it can be seen that the majority of respondents live in Vilnius (N = 315 (67.6%)), and only one-third (N = 151 (32.4%)) belonged to other groups of major Lithuanian cities, i.e., Kaunas (N = 65 (13.9%)), Panevėžys (N = 15 (3.2 %)), Šiauliai (N = 22 (4.7%)) and Klaipėda (N = 49 (10.5 %)). However, the difference between the number of respondents residing in Vilnius and other major Lithuanian cities is substantial. This can subsequently be considered a limitation of the study. The questionnaire was completed electronically, which may have led to more passive participation in the whole process. Comparative analysis based on residence was conducted despite a significant difference in the number of respondents.

The study followed the ethical principles of voluntariness and anonymity to participate in the survey.

### 4.2. Research procedure

A targeted sampling method was employed to select respondents for this research. Residents of Vilnius (the capital city) and other major Lithuanian cities with a well-developed public transportation system were included in this research. The online survey was distributed among the residents of Vilnius and other major Lithuanian cities. A margin of error of 5 percent was chosen to obtain reliable data. Based on the sample size formula, the required number of residents of major Lithuanian cities

to be surveyed was calculated (a total of 384 people). After estimating the risk of return of the questionnaires, a total of 700 questionnaires were distributed to the residents of the major Lithuanian cities. The questionnaires were filled in electronically. Over two weeks, 472 residents of the major Lithuanian cities responded to an invitation. The response rate to the questionnaires was 67.4 percent. Six questionnaires were not included in further data analysis. Four hundred sixty-six questionnaires were used for further data analysis, which is considered suitable for statistical analysis. The results obtained were processed and presented in summary, respecting the confidentiality of the data.

## 5. RESEARCH RESULTS

In the context of active globalization, the need for public transportation is undeniable. The number of people using public transportation is constantly increasing to reach their desired destination in a faster, more convenient, safer and easier way.

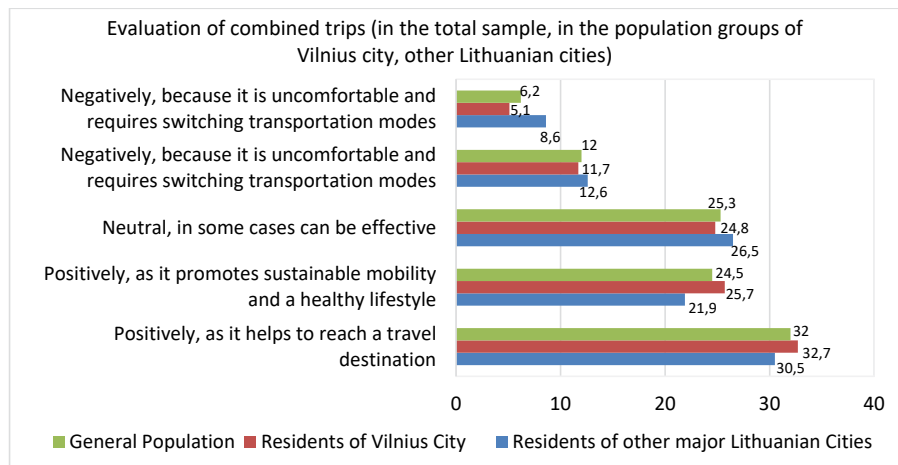
The research results have shown that most of the population of major Lithuanian cities (N = 418, i.e., 89.5%) has used public transport at least once. This is true for the city of Vilnius (90.8%) and other major Lithuanian cities (88.1%). Therefore, the promotion of sustainable mobility, implementation of sustainable development ideas, environmental friendliness of vehicles in the development of public transport infrastructure, and reduction of pollution caused by the transport sector are among the most critical objectives in the provision of public transport services. It is essential to analyze management solutions, measures, and political aspects to make public transport in Lithuania's major cities more efficient in the context of sustainable mobility and multimodality.

Sustainable mobility and multimodality contribute to sustainability in the transport sector. They are measured by the efficiency of the transport system, which depends on many different factors: the vehicles used, the diversity of transport modes and their interactions, existing mobility, and accessibility. The need to develop sustainable mobility and multimodality is therefore undeniable to ensure the efficiency of the entire transport system and reduce the environmental impact caused by transport.

Sustainable mobility and multimodality contribute significantly to the sustainability of the transport sector and are measured by the efficiency of the transport system. This efficiency depends directly on numerous factors, such as the vehicles used, their sources of operation, intermodality, existing mobility and access options, and long-term future strategies. The survey item “How do you evaluate combined transport?” allowed us to assess views on combined transport and define this phenomenon’s positive and negative aspects. The data analysis from the sample showed that more than half (56.5%) of the respondents have a positive attitude towards combined transport (Fig. 2).

According to more than a third of the survey participants, *combined travel helps reach a destination* (32.0%) and *promotes sustainable mobility and a healthy lifestyle* (24.5). Comparative analysis of the data showed that the attitudes of residents of Vilnius and other major Lithuanian cities are generally similar when evaluating combined travel. The study found stronger positive attitudes in the population towards combined travel. Chi-square criteria showed that Vilnius residents have positive attitudes towards combined travel and believe such travel can help them reach their destination (32.7%) and promotes sustainable mobility and a *healthy lifestyle* (25.7%).

The figures on these aspects are slightly different in other major Lithuanian cities (respectively, 30.5 % and 21.9 %). However, these assessments did not differ that much statistically ( $p > 0.05$ ), suggesting that positive attitudes toward combined travel were at the same level regardless of residence. Negative aspects of combined travel were admittedly mentioned more often by residents of other major Lithuanian cities. More of them mentioned having to prepare in advance (8.6%) and change means of transport during the trip (12.6%) than in the Vilnius sample (5.1% and 11.7%, respectively). Still, no statistically significant differences were found after applying the chi-square criterion ( $p > 0.05$ ).



**Figure 2.** Evaluation of combined trips in the total sample (N = 466), in the population groups of Vilnius city (N = 315), other major Lithuanian cities (N = 151), in %  
**Source:** Research results.

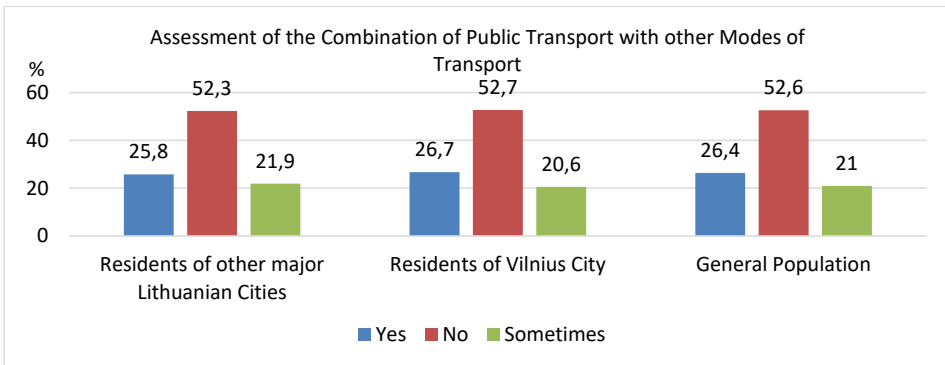
In the contemporary context, the promotion of sustainable mobility and development, the use of low-emission vehicles, and the reduction of pollution caused by the transport sector are among the priority objectives in the provision of public transport services. Sustainable mobility and multimodality contribute to sustainability in the transportation sector. They are measured by the transportation system's efficiency, which depends on many factors: vehicles used, their sources, intermodality, transportation infrastructure, operational and logistical solutions, existing mobility and accessibility options, and long-term future strategies. However, it should be recognized that the stated values and the work being done are often contradictory and inconsistent with sustainable mobility.

Analysis of participants' views on combining driving and other modes of transport shows that almost half (47.4%) of the inhabitants of the major Lithuanian cities participating in the study *combine (or sometimes combine) public transport with other*

*modes of transport*. In comparison, the rest (52.6%) do not tend to combine different modes of transport (Fig. 3). Comparative analysis of the data in the population groups living in Vilnius and other major Lithuanian cities revealed similar trends, and the data are relatively evenly distributed. There was no statistically significant difference ( $p > 0.05$ ) in the evaluation of *not combining public transport with other means of transport* between the groups living in the city of Vilnius (52.7 pct.) and other major Lithuanian cities (52.3 pct.). A statistically non-significant difference ( $p > 0.05$ ) shows that respondents living in Vilnius (26.7%) and other major Lithuanian cities (25.8%) tend to combine different means of transport to the same extent when traveling from one place to another. Although recently special attention has been paid to the diversity of means of transport and ensuring their synergy, the inhabitants of major Lithuanian cities make insufficient use of this possibility. Therefore, to achieve ecological mobility and pollution reduction, it is necessary to increase the diversity of public transport

modes and create opportunities to combine them to encourage people to switch from their cars to public transport, bicycles, walking, etc. The development and promotion of multimodality should therefore be based on an efficient and interconnected

intermodal transport system, better and more accessible modes of transport, and increased use of renewable and low-carbon fuels through cleaner modes of transport that are likely to contribute to the health and well-being of the population.

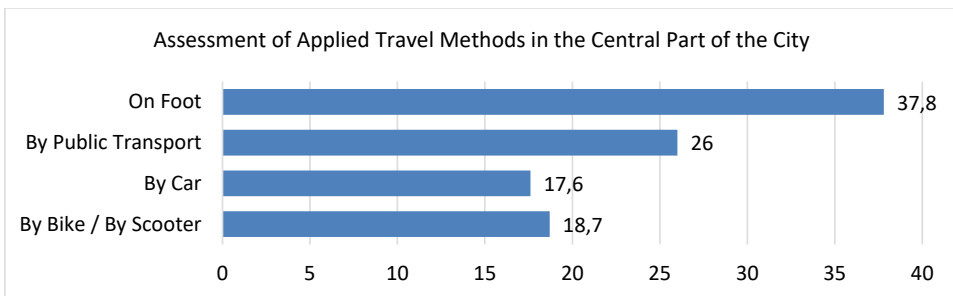


**Figure 3.** Assessment of the combination of public transport with other modes of transport in the general population (N = 466), Vilnius city (N = 315), and other major Lithuanian cities (N = 151), in %  
**Source:** Research results.

To improve transport connections and reduce traffic-related pollution, especially in the city center, it is necessary to make the best use of each mode of transport and increase synergies between them.

The survey also found that more than one-third of respondents (37.8%) walked in the central part of the city, and a slightly lower percentage (18.7%) chose to ride a bicycle/scooter. In comparison, public

transportation is used by almost one-third (26%) of the population in the central part of the city. 17.6% of the study participants travel by car in the central part of the city (Fig. 4). Therefore, to increase the impact of sustainable transport and the efficiency of the whole transport system, especially in the central part of the city, it would be appropriate to develop the infrastructure for moving around by non-motorized vehicles and create a convenient basis for their use.



**Figure 4.** Assessment of applied travel methods in the central part of the city, N = 466, in %  
**Source:** Research results.

Summarizing the results, it can be concluded that despite the positive attitude of the majority of respondents to combined transport, the combination of public transport with other modes of transport is not yet frequently used for some subjective and objective reasons. To create social, economic, and environmental well-being and consider the modernization of public transport and consumer preferences, the current situation requires optimal transport use both in the city and the city center. It is necessary to create opportunities to manage the quality of public transport services by balancing the use of private transport and public transport, adapting a more comprehensive range and variety of transport modes, managing the infrastructure, encouraging passengers to change their habits, ensuring unrestricted and unhindered passenger mobility, encouraging public transport users to give up the habit of traveling by private car, which would have an impact on the development of sustainable mobility and multimodality.

To develop a service that satisfies the needs of consumers and to ensure an efficient and high-quality service process, it is necessary to study the problem areas of public transport in the major Lithuanian cities.

According to the data analysis (Fig. 5), the highest average values of the estimates show that *inadequate and inconvenient timetables* ( $M = 2.47$ ), *lack of cleanliness in public transport* ( $M = 2.47$ ), *non-compliance with route schedules* ( $M = 2.33$ ) and the *insufficient number of public transports in the city* ( $M = 2.23$ ) are among the mentioned problems that residents of major Lithuanian cities usually face when using public transport.

Even though innovations are introduced quickly, and digitalization and its

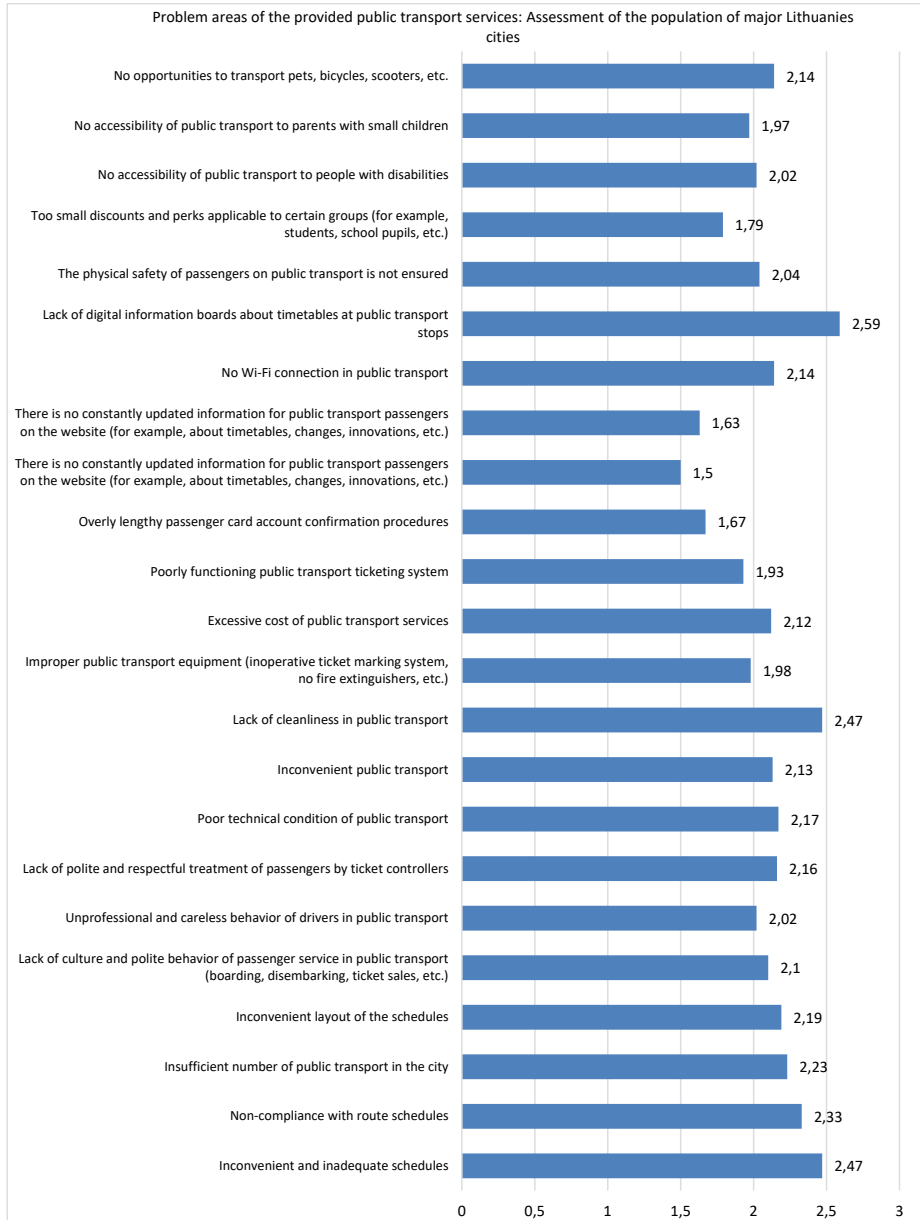
applications are implemented, the research results have shown that functional aspects of public transport service are considered a problem area by the inhabitants of major Lithuanian cities.

Analysis of the data showed that respondents cited *the lack of digital information boards about timetables at public transportation stops* ( $M = 2.59$ ) as one of the problems they most often face when using public transportation. The lowest mean estimates revealed that *the lack of constantly updated information for public transportation passengers on the website* ( $M = 1.5$ ), *lack of information for public transportation passengers about schedule changes and innovations* ( $M = 1.63$ ), and *excessively lengthy passenger card account confirmation procedures* ( $M = 1.67$ ) were the least common problems.

Comparative analysis of the data in the population groups of Vilnius and other major Lithuanian cities revealed significant differences in the estimates (see Table 2). Statistically significant mean differences ( $p < 0.05$ ) indicate that Vilnius city residents consider the following aspects as problem areas - *poor technical condition of public transport* ( $M = 2.28$ ,  $SD = 1.33$ ), *lack of cleanliness in public transport* ( $M = 2.58$ ,  $SD = 1.35$ ), *inadequate public transport equipment* ( $M = 2.14$ ,  $SD = 1.3$ ), *excessively lengthy passenger card account confirmation procedures* ( $M = 1.85$ ,  $SD = 1.5$ ). In contrast, residents of other major Lithuanian cities assessed the following aspects with significantly lower mean values: *poor technical condition of public transport* ( $M = 1.94$ ,  $SD = 1.24$ ), *lack of cleanliness in public transport* ( $M = 2.26$ ,  $SD = 1.37$ ), *equipment for service provision* ( $M = 1.63$ ,  $SD = 1.24$ ), and *length of service provision* ( $M = 1.29$ ,  $SD = 1.42$ ). Thus, the results indicate that the problem areas faced by users

of transport services are related to the poor technical condition of transport means and inadequate (or outdated) equipment and

that these elements are more pronounced as problems in the Vilnius city population group.



**Figure 5.** Problem areas of the provided public transport services: Assessment of the population of major Lithuanian cities (N = 466, M are average values, Max = 5).

Source: Research results.

# Journal of Contemporary Management Issues

Comparative data analysis of subsamples of residents of different major Lithuanian cities revealed that the following problem areas are similarly assessed - *accessibility of public transport for people with disabilities* ( $t = 1.382, p = 0.168$ ) as well as for *parents with small children* ( $t = 0.729, p = 0.466$ ), *possibilities to transport pets, bicycles, scooters, etc.* ( $t = 0.227, p$

$= 0.821$ ). The calculation of the t-test indicates the statistically non-significant difference in means ( $t = 0.223, p = 0.824$ ), which in turn shows that residents of Vilnius and other major Lithuanian cities consider *too few discounts and benefits for particular groups* (e.g., students, schoolchildren, etc.) to be a problem and rate them at a similar level (Table 2).

**Table 2.** Problem areas of the provided public transportation services: Assessment of the residents of Vilnius city (N = 315) and other major Lithuanian cities (N = 151, M are average values, Max = 5)

	Group of Vilnius City Residents		Group of other major Lithuanian Cities		t	p
	M	SD	M	SD		
Inconvenient and inadequate schedules	2.45	1.4	2.51	1.59	0.411	0.681
Non-compliance with route schedules	2.36	1.28	2.26	1.45	0.676	0.5
Insufficient number of public transport in the city	2.24	1.47	2.21	1.67	0.205	0.838
The inconvenient layout of the schedules	2.13	1.37	2.3	1.55	1.181	0.239
Lack of culture and polite behavior of passenger service in public transport (boarding, disembarking, ticket sales, etc.)	2.05	1.32	2.21	1.4	1.208	0.228
Unprofessional and careless behavior of drivers in public transport	1.99	1.36	2.09	1.31	0.771	0.441
Lack of polite and respectful treatment of passengers by ticket controllers	2.14	1.45	2.21	1.39	0.533	0.594
Poor technical condition of public transport	2.28	1.33	1.94	1.24	2.696	0.007
Inconvenient public transport	2.19	1.27	1.99	1.22	1.67	0.096
Lack of cleanliness in public transport	2.58	1.35	2.26	1.37	2.382	0.018
Improper public transport equipment (inoperative ticket marking system, no fire extinguishers, etc.)	2.14	1.3	1.63	1.24	4.04	0.001
High cost of public transport services	2.03	1.55	2.29	1.61	1.649	0.99
Poorly functioning public transport ticketing system	1.97	1.42	1.85	1.48	0.799	0.425
Overly lengthy passenger card account confirmation procedures	1.85	1.5	1.29	1.42	3.817	0.001
There is no constantly updated information for public transport passengers on the website (for example, about timetables, changes, innovations, etc.)	1.57	1.42	1.38	1.38	1.345	0.179
There is no constantly updated information for public transport passengers on the website (for example, about timetables, changes, innovations, etc.)	1.65	1.47	1.59	1.49	0.42	0.675



	Group of Vilnius City Residents		Group of other major Lithuanian Cities		t	p
	M	SD	M	SD		
No Wi-Fi connection in public transport	2.18	1.68	2.06	1.95	0.64	0.523
Lack of digital information boards about timetables at public transport stops	2.62	1.48	2.52	1.71	0.59	0.556
The physical safety of passengers on public transport is not ensured	2.1	1.4	1.91	1.45	1.362	0.174
Too small discounts and perks applicable to specific groups (for example, students, school pupils, etc.)	1.8	1.52	1.77	1.7	0.223	0.824
No accessibility of public transport to people with disabilities	2.09	1.42	1.89	1.51	1.382	0.168
No accessibility of public transport to parents with small children	2.01	1.45	1.9	1.5	0.729	0.466
No opportunities to transport pets, bicycles, scooters, etc.	2.15	1.58	2.11	1.73	0.227	0.821

**Source:** Research results.

Thus, the problems arising from the criteria associated with the possibilities of using public transport for different groups of people and the pricing policy to enjoy discounts and benefits are at a similar level regardless of the place of residence. The results of the comparative analysis showed that the residents of Vilnius and other major Lithuanian cities have similar opinions about the following problem areas: *lack of constantly updated information for public transport passengers on the website* ( $t = 0.227$ ,  $p = 0.821$ ), *lack of information on schedule changes, innovations, etc.* ( $t = 0.227$ ,  $p = 0.821$ ). The results of the analysis showed that the residents of Vilnius have opinions about the following problem areas: *lack of digital information boards about timetables at public transport stops* ( $M = 6.2$ ,  $SD = 1.48$ ) and the *no Wi-Fi connection in public transport* ( $M = 2.18$ ,  $SD = 1.68$ ), as estimated by residents of other major Lithuanian cities who participated in the survey (respectively: ( $M = 2.52$ ,  $SD = 1.71$ ) and ( $M = 2.06$ ,  $SD = 1.95$ )), but no significant differences ( $p > 0.05$ ) were found in the  $t$ -test.

To sum up, Vilnius city residents, when using public transport, rate the problems in the areas that include visible and tangible things, such as the poor technical condition of public transport and its suitability for quality service, cleanliness of service environment, and lack of order, poor speed of service delivery, significantly higher than the residents of other major Lithuanian cities that participated in the research. A comparative analysis of the data showed that the following problems are statistically rated equally high regardless of location: inconvenient and inadequate timetables, their inconvenient design, the lack of polite and respectful treatment of passengers by ticket inspectors and drivers, and the lack of information about timetable changes and innovations and the constant updating and provision of this information on digital information boards. It is essential to create a new passenger transport system that promotes sustainable mobility and multimodality, addressing the existing problems with public transport services.

There is a lack of long-term management solutions for creating a sustainable, coherent, accessible, and user-oriented public transport system in major Lithuanian cities, including physical, technological, and institutional changes in the public transport system.

## 5.1. Assessment of the implemented changes in the provision of public transportation services

Like many other countries, Lithuania has implemented numerous reforms in various areas in recent decades to meet the needs of public service users. One of the main goals is to increase the efficiency of institutions providing public services and ensure the quality of the services provided. To achieve this goal, it is undoubtedly vital to modernize public transport services,

introduce changes and consider consumers' needs and expectations. In this context, it is crucial to identify, based on the assessments of the study participants, the changes that have been made in the provision of public transport services in the last ten years while expanding the field of sustainable mobility and multimodality. Analysis of responses to an open-ended question revealed how the quality of public transportation services had been ensured as the field of sustainable mobility and multimodality has evolved over the past decade. The collected data were analyzed by qualitative processing and grouping according to semantics, context frequency, comments intensity, and response accuracy criteria. Recurring categories were identified in analyzing the changes made to public transportation over the last ten years (Table 3).

**Table 3.** Assessment of implemented changes in public transportation over the last decade

Completeness, adequacy, and availability of information on public transport services	<ul style="list-style-type: none"> <li>• Information on schedules and their changes;</li> <li>• Better (smoother) communication on social networks;</li> <li>• Diverse ways of disseminating information on the provided services.</li> </ul>
Technical condition of public transport, physical security, tidy and clean environment	<ul style="list-style-type: none"> <li>• Orderly public transport;</li> <li>• Updated public transport;</li> <li>• Green public transport;</li> <li>• Quality public transport;</li> <li>• Cleanliness at stops.</li> </ul>
Quality service provision	<ul style="list-style-type: none"> <li>• Route changes;</li> <li>• Adherence to schedules;</li> <li>• Speed of service provision.</li> </ul>
Innovations in public transport services	<ul style="list-style-type: none"> <li>• Digital information boards at stops;</li> <li>• Possibility to quickly purchase a passenger ticket online;</li> <li>• Possibility to combine public transport with other modes of transport;</li> <li>• Convenient use of the Trafi app;</li> <li>• Possibility to use telephone charging equipment in public transport;</li> <li>• More opportunities to use the Wi-Fi connection in public transport;</li> <li>• The emergence of electronic tickets on smartphones.</li> </ul>

<p>Quality in the provision of public transportation services</p>	<ul style="list-style-type: none"> <li>• Polite behavior of ticket inspectors;</li> <li>• The culture and professionalism of the staff providing public transport services.</li> </ul>
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**Source:** Research results.

When discussing the changes that have taken place in the field of public transport in the last decade, the respondents mentioned the positive aspects: *“Everything is getting better”* in terms of innovation, digitalization, modernization of public transport, and ensuring the physical safety of these vehicles and their suitability for a quality service. According to the interviewees, the number of digital information boards at public transport stops has increased in recent years: *“Most stops have digital information boards and timetables.”* Innovations are introduced for the convenience of users: *“Electronic tickets have appeared on the phone,” “Wi-Fi connection in public transport,” “Charging stations for phones,”* various apps for ordering services (such as purchase and activation of tickets): *“Apps for route planning,” “Apps like “Žiogas,” “Ticket” are beneficial when you travel by public transport. The app “Žiogas” has significantly improved the quality of service,”* which creates conditions for faster service: *“The ability to buy a ticket quickly.”*

On the other hand, respondents mentioned the abolition of old, non-ecological public vehicles: *“More new and modernized vehicles,” “Replacement of old buses with new ones,” “Abolition of all trolley buses that were previously in use for 20-30 years”.* The increasing use of green buses: *“Acquisition of new green buses.”* Thus, the analysis of the answers to an open question revealed that the modernization of public transport in the last decade and the initiation of changes are related to the implementation of sustainable development when *“old buses are replaced by new ones that are less polluting.”* Undoubtedly, the

environmental friendliness of vehicles is one of the priority areas in the development of public transport infrastructure to ensure the quality of services offered. In addition, according to the study participants, more and more attention is paid to a neat and clean environment: *“During the quarantine period, public transport is cleaner, you feel that the vehicles are cleaned ...”*, as well as on the quality of service: *“I admire when drivers get off the buses to help people with disabilities”*, *“Drivers are nice, clean and neatly dressed, sometimes even with uniforms”*, culture: *“Polite ticket inspectors”*, *“Drivers are very polite and helpful.* In addition, survey respondents noted that over the past decade there has been an increasing focus on passenger safety: *“Cameras, brighter lights,”* and adapting public transportation to different user groups: *“There are more low-floor buses, they are more comfortable, warmer, and more convenient for passengers of all ages.”* On the other hand, there is more and more emphasis on convenience and connection speed: *“Fast buses”*, *“The number of A-lanes is increasing, so the trip is faster”* and the combination of different modes of transport: *“The possibility to combine with other modes and means of transport”*, which in turn allows faster, more convenient and easier routes to a desired destination: *“It is very positive that the park-and-ride service has appeared, there are assigned places to park bicycles”*, *“Faster route time”.*

Despite the positive changes observed, analyzing the answers to an open question allowed us to identify the problem areas of public transport services and the aspects to be improved. From personal experience,

public transport users confirm that they often have problems when the information on the digital information boards is not updated and can only be found on the Internet: *"Timetables change frequently, but the changes are only visible online, and the old timetable remains at the stops."* This makes travel especially difficult for the elderly: *"I think this makes travel very difficult for the elderly because they often do not follow the news online."* On the other hand, it should be recognized that one of the essential elements for consumers in accessing public transportation is proper transit planning, convenient routes and timetables, and adherence to them. Apart from that, one of the main problems raised by the respondents is the decreasing number of vehicles: *"The buses run less frequently. In cold weather we have to wait longer", "the intervals between waiting times have increased,"* non-compliance with timetables: *"the timetable has worsened,"* vehicle delays, canceled routes: *"the number of routes has decreased,"* limited offer of public transport on weekends, uncoordinated timetables: *"before you could reach your destination with a single bus or trolleybus, now you have to change between three or four."* Undoubtedly, the latter problems are partly due to the quarantine imposed in the country, when the number of passengers and traffic flows decreased by about 60 percent and, consequently, the number of vehicles in the city was reduced. In addition, the current situation during the pandemic has created the conditions for the emergence of other problems that do not allow passengers to travel safely by public transport: *"I also noticed some bad changes - it is now a pandemic, but the seats that should not be occupied are not marked. You have to travel for 40 minutes without a safe social distance."* One of the problem areas is the lack of adaptation of the services offered to different user groups: *"Access to information*

*for seniors and people with disabilities is a nightmare."* In addition, according to respondents, there is no favorable pricing policy for seniors

In analyzing the dimensions of quality assurance of public transportation services, convenience, greater choice of public transportation, speed of service delivery, completeness and adequacy of information about the services offered, innovation, and implementation are identified as the most critical elements that determine consumer satisfaction with public transportation services. When asked how to ensure the quality of public transport services in sustainable mobility and multimodality, respondents are convinced that modernizing vehicles and increasing the number of new, environmentally friendly buses would ensure the quality of public transport services. On the other hand, there is a need for digitalization and innovation by increasing the number of digital information boards at public transport stops. In addition, to ensure the quality of the services offered, it is vital to consider consumers' individual characteristics and needs and provide them with access to various transport modes during their journey. To sum up, modernized vehicles and stops, their digital information boards, and convenient ticketing procedures with the help of apps are among the changes implemented in the last decade that should ensure the quality of public transport services and increase the satisfaction of public transport users. In the last decade, greater attention has been paid to the technical condition of vehicles, the quality of service, the implementation of innovations, passenger safety, and the convenience of public transport. Recent results show that the development and implementation of sustainable development are not sufficiently used in the management of the public transport system in the context of sustainable mobility and

multimodality. This includes criteria such as efficient use of resources in services, environmental protection, and reduction of pollution through the modernization of vehicles, etc.

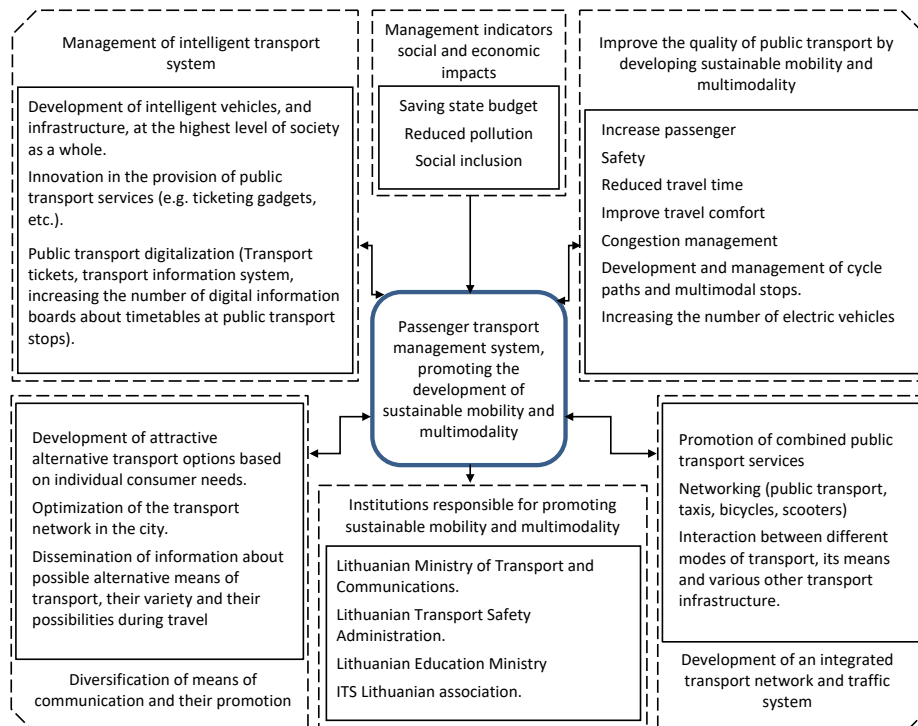
## 5.2. An integrated public management transport model

Finding solutions to this problem requires new management solutions that cover accessibility, convenience, safety, reliability, and an environmentally friendly public transport system that can contribute to economic and social prosperity. To promote the use of public transport in sustainable mobility and multimodality by the inhabitants of the major Lithuanian cities, an integrated model for the promotion of sustainable mobility and multimodality for consumers has been developed following the research results (Fig. 6).

Sustainable mobility and multimodality must be promoted to improve connectivity, ensure higher quality of public transport services, and reduce pollution in the transport sector. To ensure sustainable mobility, areas such as vehicles used, intermodality, transport infrastructure developed, operational and logistical solutions, and existing mobility and accessibility options should be considered.

Public services provided to society daily are an essential part of their lives. These services must be in the public interest. Public transportation is one of the essential components of any developed modern city. In today's world, where the influence of sustainable transport and the efficiency of the transport system are increasing, the diversity of transport modes and the opportunities for consumers to choose them according to their individual needs and possibilities are significant. The latter statement

is confirmed by the results of this research, which showed that despite the implementation of mobility management measures, no precise results and values were declared. The work carried out is often contradictory and inconsistent with sustainable mobility. To achieve positive results in providing opportunities for quality assurance of public transport services in sustainable mobility and multimodality, it is vital to pay more attention to the provision and dissemination of information about the diversity of different transport modes and their selection and application. To increase the sustainable mobility of public transport users, it would be appropriate to cover the area of *vehicle diversity and its popularity* as a necessary part of the integrated model to promote sustainable mobility and multimodality.



**Figure 6.** A model for passenger transport management system, promoting the development of sustainable mobility and multimodality

**Source:** Research results.

Convenience, safety, time savings, quality of service, low fares, etc., are among the factors determining consumers' decision to use public transportation. Quality management methods for public transportation services must be available at fixed prices and on fixed and convenient routes since one of the benefits of public transport is that it reduces air pollution and external road transport costs, such as congestion and accidents. One of the management solutions is to change passengers' habits and encourage them to stop using private cars.

To allow public transport users to combine time, convenience, safety, environmental friendliness, and financial efficiency, it is necessary to develop intermodality and the possibility of combining different means

of transport during the journey. Based on this fact, and to ensure the sustainability of the public transport sector, it is necessary to encourage consumers to use combined public transport services, develop the interoperability of different modes both within the city and in its center, and increase the number of bicycle lanes and multimodal stops in major Lithuanian cities. Therefore, developing an integrated transport network and transport system is an inseparable part of the integrated model. It can be assumed that optimal use and interaction between different modes of transport would increase mobility opportunities for residents and ensure a higher quality of public transport services offered. On the other hand, promoting the interaction of different transport modes

has the potential to increase the efficiency of a sustainable public transport system and reduce the ever-increasing environmental impact of the transport sector. Thus, considering the development trends of public transport, one of the management methods would be multimodality, integrating different modes of public transport, private cars, bicycles, and scooters, and reaching the desired destination on foot.

One of the components of the integrated model to promote sustainable mobility and consumer multimodality is meeting the needs of transportation users, which include safety, shorter travel times, comfort, convenience, well-being, and congestion reduction. The inclusion of the public transport component and service quality assurance in the development of sustainable mobility and multimodality in the integrated model is based on the premise that not only convenient timetable design, order, and cleanliness of public transport, adherence to timetables, ensuring the number of public transport services in the city, but also the speed of services provided, the convenience of travel and reduction of travel times, and congestion management on the road become particularly important for the development of sustainable mobility and multimodality. The synergy of public transport through the combination of timetables and routes, appropriate infrastructure, and accessibility are, therefore, among the most critical aspects in implementing public transport management solutions.

Fast and convenient connections are vital for the city's residents, both because of mobility and problems with congestion and pollution. Poor quality of public transportation leads to dissatisfaction among passengers and dramatically impacts their decision to look for alternatives and choose cars over public transportation. When the number of

cars increases, traffic jams occur, the time spent by both owners of their vehicles and public transport passengers increases, and pollution increases. It can be said that all this is a consequence of poor public transportation. Therefore, it is necessary to constantly monitor the changing needs of public transport users and satisfaction with the quality of services provided to avoid the above problems. In addition, providing passengers with seamless travel makes sense by reducing the increasing use of the private car and taking advantage of a flexible combination of different vehicles.

Society is placing ever greater demands on the public sector in the contemporary world, characterized by new technologies and globalization. Public services have always been one of the essential tasks of the public sector. One of the most important indicators is the digitalization of public transport, which includes tickets and a transport information system. Digitization contributes to sustainable development and the preservation of the environment. An intelligent transport system involves developing intelligent vehicles and infrastructures, with the economy valuing external benefits. Based on this fact, the integrated model should cover the aspects of introducing innovations and modernizing public transport services, aiming at developing sustainable mobility and multimodal services.

The complex model of Giannoutakis and Li (2011) to promote sustainable mobility and consumer multimodality would also include *economic-social indicators*, including savings in the state budget, fewer accidents, less pollution, and social exclusion. The transport sector contributes significantly to GDP growth. As the economy grows and the number of private vehicles increases, the same applies to the transport's negative impact on the environment.

As the number of people traveling by car increases, the transportation sector's impact on the various components of the environment also increases, as do emissions of pollutants into the atmosphere. Therefore, it is necessary to determine whether Lithuania's transport sector is developing sustainably. Thus, with the growing number of cars worldwide, fuel consumption in the transport sector is also increasing.

Lithuania's Ministry of Transport and Communications and the Lithuanian Transport Safety Administration are responsible for promoting sustainable consumer mobility and multimodality. To ensure the efficiency of the management of the public transport system in the context of sustainable mobility and multimodality, cooperation between the relevant national authorities, such as service users, providers, and operators, is essential.

## 6. CONCLUSION

This study focuses on the analysis of solutions to the problems of public transport management in major Lithuanian cities in the context of sustainable mobility and multimodality.

The theoretical part analyzes the relevant conditions for applying sustainable mobility and multimodality in public transport. This study points out problematic areas such as safety, congestion, and sustainability, as well as presents a theoretical model of the impact of sustainable mobility and multimodality on passenger transport. The article mentions that it is vital to develop the transport system, create synergies between the different modes of transport, increase the quality of transport services, reduce pollution from transport and prevent accidents.

The study shows that it is necessary to make management decisions to ensure the development of sustainable mobility and multimodality in public transport services in major cities in Lithuania.

Research has shown that most residents of both Vilnius and other major Lithuanian cities do not combine public transport with other modes. Less than one-third of survey participants combine multiple modes of transport on their trips. As the results of the study show, public transport and car are among the most frequently used modes of transport in the central part of the city, although more than one-third of the population of the major Lithuanian cities walks and uses bicycles/scooters. Therefore, it is necessary to find ways to improve the quality of public transport by creating opportunities to balance the use of private and public transport both in the city and in the central part of the city, adapting a more comprehensive range of transport modes and their diversity, managing the infrastructure, and encouraging passengers to change their habits.

The survey results show that there is still a lack of long-term management solutions for creating a sustainable, accessible, and user-oriented public transport system in major Lithuanian cities. The highest mean scores show that the lack of digital information boards, impractically designed timetables, lack of cleanliness in public transport, non-compliance with timetables, and an insufficient number of public transport vehicles in the city are problem areas in the evaluation of public transport services. The comparative analysis of data has shown that Vilnius residents are more often confronted with the poor technical condition of public transport, lack of cleanliness, inadequate equipment of public transport vehicles, and lengthy passenger card account approval



procedures when using public transport than other residents of major Lithuanian cities. Therefore, it is necessary to consider the physical and technological changes in public transport when planning quality management methods for public transport services.

According to the study participants, there are ongoing initiatives to address the existing problems of public transport services. These include the renewal of public transport vehicles, the technical condition of these vehicles, the physical safety of passengers, and the user-friendliness of public transport. However, the development and implementation of sustainable development, including criteria such as efficient use of various resources in the provision of services, reduction of pollution through modernization of vehicles, and innovation in the digitalization of services, is not sufficiently used in the management of the public transport system in the context of sustainable mobility and multimodality.

A comprehensive model for implementing public transport management solutions in the context of sustainable mobility and multimodality has been developed. This model implies the idea that in the development of services for sustainable mobility and multimodality, it is essential to include the diversity of different transport modes, their interaction, and the improvement of users' choices; the promotion of combined public transport services, the development of transport infrastructure, the current possibilities of mobility and accessibility, the development of advanced transport systems, the digitalization of services involving institutions responsible for the promotion of sustainable mobility and multimodality of consumers.

The authors of the article propose to analyze the diversification of means of communication and their promotion, the management of the development of an integrated transport network and transport system, the institutions responsible for promoting sustainable mobility and multimodality, and the management indicators of social and economic impact.

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### UNAPREĐENJE UPRAVLJANJA JAVNIM PRIJEVOZOM U NAJVEĆIM LITVANSKIM GRADOVIMA U KONTEKSTU ODRŽIVE MOBILNOSTI I MULTIMODALNOSTI

#### Sažetak

*U ovom se radu analiziraju problemi upravljanja putničkim prijevozom u kontekstu održive mobilnosti i multimodalnosti u najvećim litvanskim gradovima. Razmatraju se sustav gradskog prijevoza, njegov razvoj i problemska područja u zadovoljavanju potreba potrošača. U radu se, također, raspravlja o načinima za promoviranje usluga javnog prijevoza u području održive mobilnosti i multimodalnosti, i to kroz rješavanje problema u upravljanju putničkim prijevozom. U radu se analiziraju i stavovi stanovnika najvećih litvanskih gradova, povezani sa značajem održive mobilnosti i multimodalnosti. Prezentiraju se čimbenici, koji utječu na odluke stanovnika najvećih gradova u Litvi, vezane uz korištenje održive mobilnosti i multimodalnosti, kao i načini za njihovo unapređenje. Za istraživanje prethodno*

*navedenih stavova koriste se kvantitativne metode te se potvrđuje hipoteza o postojanju specifičnih menadžerskih problema, povezanih s održivom mobilnošću i multimodalnošću. Prema rezultatima studije, većina stanovnika Vilniusa i drugih velikih litvanskih gradova ne kombinira javni prijevoz s drugim oblicima prijevoza, a tek manje od jedne trećine ispitanika kombinira više-struke oblike prijevoza. Provedba rješenja iz područja upravljanja javnim prijevozom u kontekstu održive mobilnosti i multimodalnosti bi trebala postati opće prihvaćenim modelom.*

**Ključne riječi:** *upravljanje putničkim prijevozom, putnički prijevoz, održiva mobilnost i multimodalnost, javne prijevozne usluge, evaluacijski indikatori*