THE TRANSPORT SYSTEM IN BUCHAREST-ILFOV REGION IN ROMANIA: THE PATH TOWARDS SUSTAINABILITY

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Abstract
The study analyses the transport system in Bucharest-Ilfov, the most developed region in Romania in order to identify the challenges in managing its development and solutions for improving urban mobility and promote a more sustainable transport system infrastructure in the area. The objectives of the research are: (1) To investigate citizens' opinions in Bucharest-Ilfov region regarding the transport infrastructure in the area; (2) To analyse citizens' degree of satisfaction regarding public transport in Bucharest-Ilfov region; (3) To investigate the main problems and challenges of the public transport system and transport infrastructure in the region and propose solutions for improving urban mobility in a sustainable manner. The methodology of the study consists of an opinion survey conducted by the authors within the citizens of Bucharest-Ilfov region in Romania, in order to find out their opinions regarding the transport infrastructure and the local transport system in the region. The research emphasizes the need for the strategic implementation of sustainable transport solutions that promote environmentally friendly mobility, reduce greenhouse gas emissions, and ease traffic congestion. Furthermore, in the context of the accelerated urbanization of the Bucharest-Ilfov region, the development of a sustainable transport system is becoming a key factor in ensuring balanced, resilient and environmentally friendly urban growth.

Keywords: urban mobility, sustainability, Bucharest-Ilfov region, local public transport system
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1. Introduction

Sustainable transport represents a key pillar of sustainable development, as it is directly referenced in several Sustainable Development Goals (SDGs) and significantly influences their achievement. Sustainable mobility systems aim to reduce greenhouse gas emissions and environmental impacts while ensuring safety, accessibility, and improved energy efficiency. At the same time, they seek to guarantee equitable access to mobility for all population groups (UNDP, 2025).

Sustainable transport systems contribute to enhancing social cohesion, mitigating environmental challenges, and promoting economic efficiency (Clitan, 2014). This holistic vision applies across all transport modes and geographical areas, positioning transport as a critical enabler of sustainable development in general and climate action in particular.

Sustainable transport is a complex system designed to meet people's mobility needs and the movement of goods and materials under optimal conditions, while significantly minimizing adverse environmental impacts. Globally, the transition to sustainable transport systems has become imperative. Significant investments are being directed toward policies that promote the adoption of non-polluting vehicles, the rehabilitation of infrastructure, and the optimization of logistics and transport routes (UNDP, 2025).

At the European level, the introduction of sustainable and innovative transport solutions is essential for meeting EU's energy and climate objectives. According to analyses conducted at EU level, the transport sector remains heavily dependent on oil and oil-derived products—a situation that is unsustainable both environmentally and economically (EU, 2025). By 2050,

the EU aims to reduce transport-related greenhouse gas emissions by 60% compared to 1990 levels and to significantly curb pollution generated by vehicles. Despite these ambitions, disparities in transport infrastructure persist across EU member states, and the region faces increasing competition from rapidly developing transport markets in other parts of the world.

Consequently, sustainable transport has become a matter of strategic importance, and its development depends on a range of interrelated factors, including the design and monitoring of strategies aligned with sustainable development objectives, allocation of public funds, access to non-reimbursable financing, provision of incentives, and the awareness and engagement of both individuals and organizations in shifting towards sustainable transport solutions.

In this respect, the present research analyses the transport system in Bucharest-Ilfov, the most developed region in Romania in order to identify the challenges in managing its development and solutions for improving urban mobility and promote a more sustainable transport system.

The study started from the following hypothesis:

H1: The transport infrastructure in the Bucharest-Ilfov region does not meet citizens' needs.

H2: Citizens' general level of satisfaction with public transport system in the region is low.

H3: The main problems of the public transport system are traffic jams and overcrowding.

The paper is structured as it follows: the first section comprises the literature review on sustainable transport, followed by main consideration about transport system and Romania and relevant information on Bucharest-Ilfov region. After the theoretical background, the research objectives and methodology are presented. The next part of the study focuses on the presentation of the main results followed by the discussions and conclusions section.

2. Literature review

2.1. Theoretical background regarding sustainable transport

Transport sector is one of the main sources of greenhouse gas emissions, representing a major challenge for global environmental protection strategies (Ferro, Ramos & Ferrero, 2025). In the European Union, this sector generates approximately one-quarter of CO_2 emissions, emphasizing the need for policies focused on reducing negative environmental impact (European Commission, 2019).

Current policies promote the transition to green mobility through measures such as encouraging electric vehicle use, developing public transport infrastructure, and traffic optimization via smart technologies. These initiatives contribute to reducing pollution and improving urban quality of life (Banister, 2008a; Bakogiannis, 2018).

Additionally, transport's impact on natural resource use requires a reevaluation of infrastructure project priorities. A sustainable approach includes integrating renewable energy, reducing dependence on fossil fuels, and promoting active transport modes such as walking and cycling (Amheka, 2018; Rodrigue, 2020; Ferro, Ramos & Ferrero, 2025).

For example, a study conducted in the Nordic countries (Banister, 2008b) showed that European cities that implemented integrated transport policies (public transport, cycling networks, walking solutions) reported significant greenhouse gas reductions and improved air quality. Also, cities with efficient public transport and cycling infrastructure reduced the usage of private vehicles by up to 30%. In Copenhagen, considered a leader in sustainable mobility, 40% of citizens cycle daily which led to a decrease in car use by 15% (Pucher & Buehler, 2017). Another research (Givoni, 2012) that also focused on integrated approach of the transport policy showed similar results, meaning that cities combining public transport with active mobility measures such as walking and cycling reduced private cars use by up to 25% and CO_2 emissions by 18%, leading to better air quality and lower noise pollution. In another study on the same subject, the author (Vuchic, 2017) concluded that cities investing in electric transport (buses, trams) achieved operational cost savings, pollution reduction, and 30% increased public transport use. In Amsterdam for example, electric transport reduced city CO_2 emissions by 20%, with electric buses representing around 25% of the fleet.

Recent advancements in the field of sustainable transportation further highlight emerging trends and best practices aimed at mitigating environmental impacts and enhancing urban

mobility. A study conducted by Litman (2017) emphasizes the role of electric vehicles and carpooling as effective strategies for reducing CO_2 emissions. In many European urban centers, the adoption rate of electric vehicles has increased by up to 50% in recent years, yielding substantial environmental benefits. For instance, in Berlin, the demand for EVs has risen by 40% over the past four years, with local authorities reporting significant improvements in air quality and a measurable decline in pollution levels.

These research indicate that urban areas which have implemented dedicated infrastructure for these sustainable modes have achieved substantial reductions in private car usage, along with measurable improvements in urban mobility.

Nevertheless, the development and implementation of sustainable transport policies remain a complex and multifaceted processes (Casas et al., 2012, Bakogiannis et al., 2018). These efforts are often impeded by a range of economic, political, cultural, and infrastructural barriers. The effectiveness of sustainable mobility initiatives is therefore closely linked to the ability of policymakers, institutions, and local communities to address and mitigate these challenges (Holden et al., 2019). Existing literature identifies several critical factors that influence the successful adoption and long-term impact of sustainable transport strategies (Holden, Giplin & Banister, 2019; Jeyaseelan et al., 2022), one of them being digitalization, a key enabler in the structural evolution of urban mobility systems (Creutzig et al., 2019; Schippl & Arnold, 2020; Havryliuk et al., 2021).

In numerous metropolitan areas, the adoption of mobile transport applications, offering real-time data, route optimization, and multimodal trip planning, has significantly contributed to reducing traffic congestion and enhancing the efficiency of public transport networks (Siuhi, & Mwakalonge, 2016; Seliverstov et al., 2020). For example, evidence from cities such as London and Paris indicates that the implementation of integrated mobility platforms has resulted in a 15% reduction in travel time and a 10% decrease in private car usage. Furthermore, users of these applications have reported notable improvements in travel satisfaction and reductions in stress associated with traffic conditions (Psaraki & Pagoni, 2012; Kamargianni et al., 2015; Fontes et al., 2017).

Furthermore, infrastructure challenges arise due to the limited spatial capacity of urban areas and the difficulties associated with embedding new transportation systems into pre-established urban environments (Vuchic, 2017). Notably, cities such as Paris and New York have made significant strides in upgrading their infrastructure to facilitate electric public transit and promote active mobility. However, these advancements have necessitated substantial financial investment and long-term strategic planning. In contrast, smaller or less developed urban centers face compounded difficulties due to the lack of essential infrastructure needed to sustain efficient public transport systems, as well as car-sharing and cycling networks.

A major obstacle to implementing sustainable transport policies remains the issue of financing. Infrastructure investments, such as expanding public transit systems, constructing dedicated cycling infrastructure, and supporting the transition to electric mobility, require substantial financial resources. However, many local governments operate under constrained budgets and lack sufficient funding to support large-scale sustainable transport initiatives. As a result, the long-term success of such policies often depends on securing diverse and stable funding sources, including public-private partnerships and targeted government subsidies (Pedrana, 2013; Kadyraliev et al., 2022; Zhang & Cheng, 2023). A relevant example is London, where the expansion of the public transport system, particularly through the development of new underground lines, has faced significant funding challenges due to high capital costs, resulting in implementation delays (Litman, 2017). Another challenge is political opposition to the enforcement of sustainable mobility strategies, particularly those targeting a decrease in private car usage (Bannister, 2008a). For instance, in several cities across the United States, local governments have faced opposition from both transport sector stakeholders and members of the public, who perceive investments in public transit and cycling infrastructure as limiting individual freedom of mobility.

Also, an important aspect in achieving sustainable transport is related to profound cultural shifts. In German cities, where cycling and public transportation are widely adopted, this transition was underpinned by long-term educational initiatives and awareness-raising efforts aimed at reshaping mobility habits. A significant portion of this success is attributed to

comprehensive public campaigns and the systematic development of infrastructure tailored to the needs of cyclists and pedestrians (Pucher & Buehler, 2017). Conversely, the promotion of public transportation in contexts such as the United States and Brazil has been impeded by a deeply ingrained automobile-centric culture. Addressing this issue necessitates the design and implementation of strategic interventions focused on altering public perceptions of transit, particularly through improvements in service quality and passenger comfort (Fang at al., 2022; Mohammed et al., 2023).

2.2. Main considerations on public transport in Romania

Public transportation constitutes a fundamental component in advancing sustainable urban mobility and in reducing the environmental footprint associated with urbanization. In alignment with the European Union's environmental policy framework, Romania is currently undergoing a progressive transformation towards a more sustainable and ecologically responsible public transport system. Traditionally, the public transport sector in Romania has been a notable contributor to greenhouse gas (GHG) emissions. Nonetheless, in recent years, local and national authorities have initiated a series of measures aimed at decarbonizing the sector. These include the integration of electric buses, the modernization of transport infrastructure, and the expansion of low-emission transit networks. Such efforts signify a strategic shift towards compliance with EU climate objectives and the enhancement of environmental quality in urban areas.

Public transport represents a major source of carbon dioxide (CO_2) emissions and other air pollutants. In the majority of Romanian cities, buses, trams, and trolleybuses have historically relied on fossil fuels, thereby contributing significantly to urban air pollution and elevated greenhouse gas (GHG) emissions. According to data published by the Ministry of Environment, Waters and Forests (2022), road transport is responsible for approximately 30% of the country's total CO_2 emissions. Furthermore, the emissions of nitrogen oxides (NO_x) and fine particulate matter ($PM_{2.5}$) are considerably higher in densely populated urban areas, where public transport constitutes a substantial proportion of overall mobility. These findings underscore the environmental challenges associated with conventional public transport systems in Romania and emphasize the need for cleaner, more sustainable alternatives (Ministry of Environment, Waters and Forests, 2022).

Between 2019 and 2020, carbon dioxide (CO_2) emissions generated by public transport in Romania's major urban centers were estimated at approximately 0.45 million tons per year (Ministry of Environment, Waters and Forests, 2022). These emissions primarily originated from conventional buses and trams powered by diesel and gasoline. In addition to greenhouse gas emissions, noise pollution and the release of fine particulate matter (PM) were identified as significant public health concerns.

To mitigate the environmental impact of public transport, Romanian authorities have implemented a range of measures aimed at enhancing sustainability and energy efficiency across the sector. Key initiatives include (Ministry of Transport, 2025):

- deployment of electric and hybrid buses: Beginning in 2020, several Romanian cities, including Bucharest and Cluj-Napoca - introduced electric buses on major public transport routes. According to the Ministry of Transport (2022), these initiatives have resulted in a notable decrease in CO_2 emissions, with reductions of up to 20% reported in areas where electric buses have been deployed.
- modernization of tram and trolleybus networks: in numerous large cities, tram and trolleybus systems have been expanded and upgraded to operate on cleaner electricity sources.
- development of green infrastructure: complementary to the adoption of low-emission vehicles, the expansion of charging infrastructure for electric buses and the installation of electric bicycle docking stations have facilitated the transition to sustainable urban mobility. These infrastructure projects, supported by European Union funding, have been implemented across several major cities in Romania (Ministry of Transport, 2025).

Collectively, these efforts reflect Romania's alignment with broader European environmental objectives and demonstrate a strategic commitment to decarbonizing the urban transport sector. Romania has undertaken a series of strategic actions aimed at advancing the

development of environmentally sustainable public transport systems. Key among these initiatives are the following:

- The National Strategy for Sustainable Urban Mobility adopted by the Romanian Government, this strategic framework aims to reduce CO_2 emissions and enhance the efficiency, accessibility, and environmental performance of public transport services. As reported by the Ministry of Transport (2022), the strategy envisions substantial public investments in low-emission and zero-emission transport infrastructure by 2030.
- utilization of European Union Funding. Romanian municipalities have actively accessed European structural funds to implement sustainable transport projects. Through the Regional Operational Programme (ROP), major urban areas have secured funding for the acquisition of electric buses and the modernization of public transport infrastructure, aligning local development efforts with broader EU climate and mobility goals (Ministry of Investments and European Projects, 2025).
- Local Sustainable Urban Mobility Plans (SUMPs). Many cities have adopted SUMPs that set out specific objectives and measurable targets to increase the proportion of environmentally friendly transport within the urban mobility mix. These plans are essential tools for guiding the long-term transition towards sustainable urban mobility at the local level.

Notable progress has been recorded in cities such as Bucharest and Cluj-Napoca. In Bucharest, a large-scale bus fleet modernization project was launched in 2020, replacing aging diesel vehicles with electric buses. According to data from Bucharest Municipality (2024), by 2023, approximately 30% of the city's bus fleet had been electrified, resulting in a significant reduction in CO_2 emissions and a marked improvement in urban air quality.

Cluj-Napoca has also implemented a similar program, initiating the introduction of hybrid and electric buses in 2021. According to reports published by Cluj-Napoca City Hall (2021), CO_2 emissions from public transport declined by approximately 15% within the first two years of the project, demonstrating the effectiveness of clean vehicle adoption in reducing the environmental footprint of urban mobility.

As part of the National Recovery and Resilience Plan (PNRR) adopted by the European Commission on September 21, 2021, Component 4 – Transport has been allocated a budget of €7.6 billion. The primary objective of this component is to enhance the sustainability of Romania's public transport system by supporting the green and digital transition through the development of durable, environmentally friendly infrastructure that meets appropriate safety standards. The component also aims to stimulate the transition toward a nationally sustainable transport model, emphasizing the implementation of environmentally friendly solutions (Ministry of Investments and European Projects, 2023).

To achieve this overarching objective, two major reforms have been outlined:

1. Sustainable Transport, Decarbonization and Road Safety,
2. Efficient Transport Management – aimed at improving institutional capacity for governance and corporate management.

In addition, four major investment priorities are being pursued:

- Modernization and renewal of railway infrastructure,
- Acquisition of new railway rolling stock,
- Development of sustainable road infrastructure on the TEN-T network,
- Expansion of the metro transport network in Bucharest and Cluj-Napoca.

Complementarily, under the Transport Programme 2021–2027, several state aid schemes have been launched to support energy efficiency in transport (Ministry of Transport, 2025), including:

- "e-Mobility RO" Programme – targeting the development of electric vehicle charging infrastructure along the national network of highways, expressways, and national roads. The programme has a total budget of €299 million, with projects to be completed by December 31, 2030.
- "e-MOVE RO" Programme – aimed at promoting zero-emission mobility infrastructure to support businesses and local communities. It has a budget of €250 million and an implementation deadline of December 31, 2028. Eligible beneficiaries include enterprises (micro, small, medium, and large), as well as state-owned companies and legally established public entities.

- Amendment and expansion of the State Aid Scheme for investments in inland waterway transport infrastructure, with a total budget of €150 million, and a final implementation deadline of June 30, 2030. The programme targets the acquisition of container-type modular battery charging stations, on-site renewable energy generation systems, and associated energy storage solutions.

Investments in Romania's transport sector are expected to contribute significantly to economic development, reduction of regional disparities, and overall improvement of mobility, particularly urban mobility.

In recent years, in the context of ongoing urban development, the concept of sustainable urban mobility has gained increasing importance in Romania. It reflects a growing concern for sustainability and efficiency in urban transport systems. In this regard, Law no. 155/2023 provides the legal framework necessary to promote and manage sustainable urban mobility at the national level.

According to Article 3 of the Law, sustainable urban mobility is defined as:

"the field that provides the strategic and operational framework for aligning urban planning and development with the transport of people and goods at the neighborhood, city, and metropolitan levels." (Romanian Parliament, 2023).

This approach contributes to reducing both traffic congestion and pollution, two of the most pressing issues facing urban areas in Romania. It promotes the use of efficient public transport and alternative modes of travel, such as walking and cycling. Consequently, in major urban centers, the implementation of effective sustainable mobility strategies is a sine qua non condition for achieving efficient and resilient sustainable development (Romanian Parliament, 2023).

2.3. Bucharest-Ilfov region- main aspects

The Bucharest-Ilfov region represents one of the most economically developed areas in Romania. Bucharest functions as the central economic hub and exerts a polarizing influence on Ilfov County, attracting and concentrating a significant share of the region's economic activities. With a population exceeding 2 million inhabitants and contributing approximately 10.5% to the national Gross Domestic Product (GDP), Bucharest is the most important economic center in the country (Bucharest Municipality, 2024).

Despite being the smallest administrative region by area, the Bucharest-Ilfov region is the most densely populated in Romania, comprising approximately 2,655,573 residents (National Institute of Statistics, 2021). Of this total, 81% reside in Bucharest and 19% in Ilfov County (Bucharest Municipality, 2024). The region's population has shown a consistent upward trend. A notable demographic shift involves residents relocating from Bucharest to Ilfov County while continuing to commute to the capital for employment. Furthermore, the official population figures may underestimate the actual number of inhabitants, as a substantial number of individuals reside in the region without having formally registered their residence, thus contributing to an unofficial but significantly higher population count.

In Bucharest, areas with the highest population densities are primarily located along major European and national road corridors, such as the E81 (including neighborhoods like Cotroceni, Militari, Preciziei, Dristor, and Trapezului) and in proximity to national roads DN4, DN5, and E85 (including Progresul, Industriilor, and Apărătorii Patriei). These densely populated zones frequently overlap with areas of recent urban expansion, particularly those governed by Zonal Urban Plans (PUZs) approved at the municipal level. Such areas are predominantly situated on the outskirts of the city, where land availability facilitates new residential development.

A clear spatial trend can be observed, wherein residents exhibit a preference for neighborhoods situated near major road infrastructure. The urbanized zones contributing to this expansion are largely residential in nature and are typically concentrated around high-capacity public transport nodes, such as Nicolae Teclu, Anghel Saligny, Valea Ialomiței, and Militari. Additionally, other expansion areas have emerged with specific functional profiles: industrial (e.g., along Splaiul Unirii) or recreational (e.g., around Lake Herăstrău). Conversely, the lowest population densities - fewer than 1,000 inhabitants - are found in peripheral natural areas, such as those surrounding the Zoo and Băneasa Forest, as well as Chitila Dendrological Park. Low-density zones are also observed near industrial zones (e.g.,

Berceni Industrial Area, Pantelimon Depot) and commercial peripheries adjacent to the Ilfov County border (e.g., West Park).

The most prevalent population size across Bucharest's traffic analysis zones ranges between 10,000 and 30,000 inhabitants. This distribution is relatively balanced between central and peripheral areas, reflecting both historical urban cores and newly developed residential districts (Bucharest Municipality, 2024).

Despite the rapid population growth observed in Ilfov County, the municipality of Bucharest continues to exhibit a negative demographic trend. Data from the most recent national censuses (2011 and 2021) indicate a steady depopulation of the capital city in favor of surrounding localities within Ilfov County, which are experiencing consistent population gains. This demographic shift is driven by multiple factors, including improved environmental quality in peri-urban areas and the availability of construction land at comparatively lower prices.

While Bucharest retains its role as the dominant economic and administrative center in the region, Ilfov County has increasingly assumed the residential function, giving rise to a widespread phenomenon of suburbanization and daily commuting. This pattern of metropolitan development introduces a series of challenges related to urban mobility, such as increased commuting flows, reduced accessibility to essential services, heightened environmental pollution, and escalating traffic congestion. These pressures have direct implications for the overall quality of life and sustainability of the Bucharest-Ilfov metropolitan area (Bucharest Municipality, 2024).

The Bucharest-Ilfov region exhibits a comparatively low incidence of population residing in disadvantaged areas. Data from the World Bank (2016) indicate that 78.87% of the region's stable population lives in non-disadvantaged areas, whereas 7.81% experience housing-related deprivation. Moreover, the region registers the lowest proportion of population living in marginalized rural areas in Romania, accounting for only 0.6%. Notably, rural marginalization within the region is predominantly concentrated in communities with a higher presence of Roma populations, underscoring persistent issues of social exclusion and limited access to essential public services.

The Bucharest-Ilfov region constitutes the most significant road transportation hub in Romania. It serves as a convergence point for three motorways that are part of the Trans-European Transport Network (TEN-T) corridors, alongside eight national roads and eleven county roads arranged in a radial pattern. These are interconnected through the Bucharest Ring Road and the A0 motorway, the latter currently under construction. Within Ilfov County, the overall quality of road infrastructure is relatively high. All national roads have been fully modernized; however, only 40% of county roads have undergone modernization, while 55% feature light road surfacing. As a result, inter-locality connectivity is generally adequate, with only 5% of county roads in substandard condition - comprising 2% paved but degraded roads and 3% unpaved (dirt) roads.

In contrast, the condition of communal roads is notably poorer. Approximately 14% are classified as being in unsatisfactory condition, including 11% gravel roads and 3% dirt roads. Moreover, communal roads have not benefited from modernization efforts, with 86% featuring only light road surfacing, indicating significant infrastructure deficits at the local level.

Employment in the Bucharest-Ilfov region is heavily concentrated in two primary areas: the central ring (also referred to as the central quadrangle), which exhibits a job density of approximately 20,000 jobs per square kilometer, and the northern part of the capital, particularly the emerging Aurel Vlaicu–Pipera business center, which hosts over 65,000 jobs. The road network experiences significant congestion in the northern sectors of the municipality, where transit traffic from Sectors 3, 4, and 5, as well as from adjacent localities, converges toward central, northern, and western districts of the city.

These employment hubs function as major attractors of commuter flows from the wider metropolitan area, including Ilfov County and beyond, thereby generating increased transport demand on both national and county-level radial road infrastructure. Under typical traffic conditions, the Pipera hub has the potential to draw commuters from a catchment area encompassing up to 3 million residents, reachable within a 60-minute travel time. This area

includes, for example, the city of Ploiești - located approximately 50 kilometers from Pipera - owing to its direct motorway connectivity (Bucharest Municipality, 2024; IHS, 2016).

Traffic analysis indicates a substantial increase in vehicular volumes since 2015, primarily driven by population growth in Ilfov County - the fastest-growing county in Romania, as reported in comparison to the 2011 census. On average, traffic volumes across all monitored routes have increased by 65.5% compared to 2015 levels. Congestion is particularly acute along the Bucharest Ring Road, where capacity constraints persist despite the construction of new overpasses. Inadequate infrastructure profiles - such as the southern segment of the ring road, which provides only one lane per direction - exacerbate these issues.

The significant transport demand originating from Ilfov County, largely directed toward Bucharest, leads to severe bottlenecks at nearly all intersections with the ring road during peak hours. Furthermore, congestion persists beyond the ring road, as Bucharest's internal road infrastructure lacks the capacity to accommodate the incoming flows from Ilfov and adjacent counties. Given the limited potential for road widening in the capital due to spatial constraints, managing demand becomes essential. This includes encouraging a modal shift toward more efficient and sustainable transport options, such as public transit and non-motorized travel.

Within Bucharest itself, all arterial roads leading to the central areas are characterized by high or very high congestion levels, not only during peak hours but often throughout the entire day. The concentration of employment in the northern part of the city - particularly in zones such as Piața Presei Libere, Pipera, Aurel Vlaicu, and Piața Victoriei - further intensifies congestion, resulting in persistent traffic delays across all access routes, irrespective of origin or direction of travel (Bucharest Municipality, 2024).

Bucharest functions as Romania's principal railway hub, strategically integrated into the Trans-European Transport Network (TEN-T). The city is traversed by the TEN-T Rhine - Danube Corridor via railway lines 300 (towards Ploiești–Brașov), 900 (towards Craiova), and 800 (towards Constanța), ensuring connectivity with major European destinations such as Strasbourg (France), and key ports on the Baltic Sea (e.g., Rostock) and the North Sea (e.g., Wilhelmshaven or Bremerhaven). Additionally, Bucharest is intersected by the TEN-T Baltic Sea–Black Sea–Aegean Corridor through line 300 and line 902 (towards Giurgiu–Ruse), enabling rail access to major maritime nodes including Gdańsk (Poland) on the Baltic Sea and Athens (Greece) on the Aegean Sea.

The total length of the railway network within the Bucharest–Ilfov region is 605.70 kilometers, with approximately 31% located within the municipality of Bucharest and 69% in Ilfov County. The region also records the highest railway network density in Romania, at 165.30 km per 1,000 km² - nearly four times the national average of 45 km per 1,000 km².

Despite this extensive network, approximately 30% of the railway lines in Ilfov County are currently non-operational, including the Bucharest Railway Belt, which remains unused. Of the entire network, only railway lines 300 and 800 have undergone modernization, permitting speeds of up to 140–160 km/h on certain sections. These upgraded lines offer competitive travel times, positioning rail transport as a viable alternative to road-based mobility within and beyond the region (Bucharest Municipality, 2024).

Despite the region's extensive rail infrastructure, train usage for daily commuting in the Bucharest–Ilfov area remains limited due to a combination of systemic and infrastructural shortcomings. One of the primary issues is the low frequency of regional trains, which typically operate as all-stop services and follow schedules that are insufficiently aligned with current commuting patterns and peak demand. The system remains largely oriented towards intercity connections rather than metropolitan mobility needs.

Furthermore, the existing rolling stock is outdated and provides a low level of comfort, which further discourages usage. Crucially, there is a lack of stations in key economic and development zones that serve as major employment hubs, such as Pipera or Institutul Fundeni, as well as in locations with potential for intermodal integration. The network itself is degraded in many areas, often consisting of single-track lines that limit capacity and reliability.

Railway stations are generally in poor condition, frequently lacking accessibility features, particularly with regard to platform access, and fail to provide basic amenities expected of modern intermodal nodes, such as parking facilities, waiting areas, or commercial services. In

addition, the railway network is not functionally integrated with the metropolitan public transport system, limiting multimodal connectivity. Several high-growth development areas, including Pantelimon and Dobroești, are spatially disconnected from the rail network, further reducing its relevance for local commuting.

Lastly, the absence of an integrated fare system with Bucharest's public transport network, except for the airport rail line, creates additional barriers to seamless travel across transport modes, disincentivizing potential users from adopting rail for daily commuting.

3. Methodology of research

The present research is an exploratory study conducted with the main purpose of analysing the transport system in Bucharest-Ilfov, the most developed region in Romania in order to identify the challenges in managing its development and solutions for improving urban mobility and promote a more sustainable transport system.

The main objectives of the study are:

Ob1. To investigate citizens' opinions in Bucharest-Ilfov region regarding the transport infrastructure in the area.

Ob2. To analyse citizens' degree of satisfaction regarding public transport in Bucharest-Ilfov region.

Ob3. To investigate the main problems and challenges of the public transport system and transport infrastructure in the region and propose solutions for improving urban mobility in a sustainable manner.

The research methodology consists of an opinion survey conducted by the authors within the citizens of Bucharest-Ilfov region in Romania, in order to find out their opinions regarding the transport infrastructure and the local transport system in the region. The survey was based on a quesstionaire designed by the authors that comprised closed questions measured on Likert scale or with several answer choices. The questionnaire was structured in four parts: the main characteristics of the sample, the opinion regarding the transport infrastructure in the region, the perception about the public transport system and problems and solutions for improving the urban mobility in the region. The questions used were created based on other studies conducted in different countries regarding citizens opinions on the transport system and infrastructure (e.g. Fiorio et al., 2013; Cusatellia et al., 2016; Romero-Subia et al., 2022)

The sample of the study was formed by 250 respondents, residents from Bucharest and other administrative territorial units from Ilfov county. The sampling method was the convenience one, a nonprobabilistic method where the respondents were chosen based on the accesibility criterion. The accesibility to the sample is a limitation of the study as it is very hard to have access to persons willing to respond to questionnaires. Being an exploratory study aiming to investigat perceptions, the sample is not representative for the whole country, but is pretty important for forming an objective opinion about the local transport system and the infrastructure in the region and what improvements does it need for a more sustainable future. In addition, the sample could not be representative for all the Romanian regions because Bucharest-Ilfov is a region with many particularities. First of all, it is the most developed region in the country, ranking on the first place on many economic indicators such as GDP/capita, employment, number of companies, number of graduates or research, development and innovation. The disparities between this region and the other ones are very high and did not succed in lowering during years. The region has the characteristics of a region experiencing rapid growth confronting with overpopulation and high level of pollution. Also, it cannot be compared with the other regions in the country regarding the size, being the smallest of the eighth regions in Romania. In order to research sustainability issues, this region is the first that should be analysed due to its major problems regarding pollution, transport and the increasing number of residents which lead to a decrease in the quality of life.

Table 1: The main characteristics of the sample

Item	Categories	Percent
Age	Under 25 years old	7.25%
	25-34 years old	18.36%
	35-44 years old	27.54%
	45-54 years old	22.71%

Item	Categories	Percent
	55-64 years old	15.94%
	Over 65 years old	8.2%
Gender	Men	36.71%
	Women	63.29%
Education	Highschool	26.57%
	Bachelor degree	41.06%
	Master degree and PhD	32.37%
Occupation	Full-time employee	59.9%
	Part-time employee	5.31%
	Freelancer	3.38%
	Student	13.52%
	Retired	9.18%
	Unemployed	6.76%
	Other	1.95%
Residence	Bucharest	65.7%
	Ilfov	34.3%

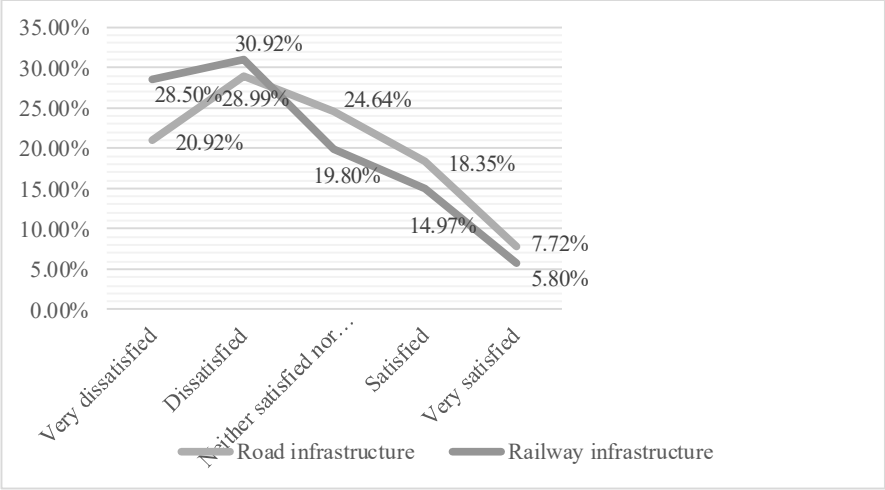
Source: authors, own interpretation

Table 1 presents the main characteristics of the sample involved in the study. There were taken into consideration aspects such as age, gender, education, occupation and residence. Most of the respondents were residents of the capital city, Bucharest and one third of them were from other territorial administrative units from Ilfov county. As Bucharest hosts the most of the population in the region the distribution of the sample based on residence is a normal one. Regarding age, most of the respondents were between 35 and 54 years old. Concerning gender, two thirds of the sample was comprised by women and one third by men. Regarding the occupation of the respondents, there were covered all types of situations. Most of the respondents were employees, full-time and part-time, the category of persons most prone of using the transport system daily.

4. The main results of the study

4.1. The transport infrastructure

Figure 1: The perception regarding road and railway infrastructure in the region



Source: authors, own interpretation

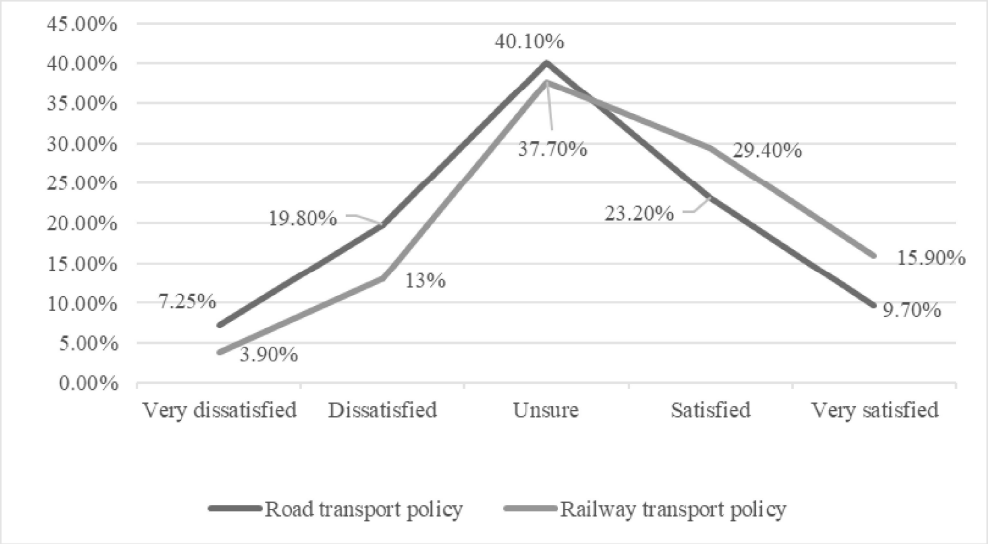
Regarding the level of satisfaction of the transport infrastructure in the region (measured on 5 point Liker scale), it can be observed that the citizens of the region are more satisfied with the road infrastructure compared with the railway infrastructure. Despite being the most developed region of the country, it seems that half of the respondents are dissatisfied with the transport infrastructure and around 20% have a neutral opinion. A critical view of the railway transport system is supported by several interrelated factors that significantly affect user satisfaction. Among the most pressing issues are the deteriorated state of railway

infrastructure and train stations, the use of outdated trains, and frequent - often substantial - delays, which undermine the system's reliability and efficiency.

Similarly, negative perceptions of road infrastructure, particularly in the capital, stem from multiple systemic shortcomings. These include an underperforming public transport network, exacerbated by the absence of dedicated lanes, an aging vehicle fleet, limited implementation of digital technologies at transport stations, and road infrastructure that is inadequate in relation to the growing volume of traffic. Moreover, the continued lack of a fully completed ring road around the capital further aggravates congestion, making travel within the metropolitan area increasingly difficult and inefficient.

Also, another problem is the subway system which is not extended in all the neighbourhoods of the capital and is not connected well with the railway system. The capital does not have a good infrastructure which connects the subway, busses, trains and trams and this could also be a major cause of this negative perception.

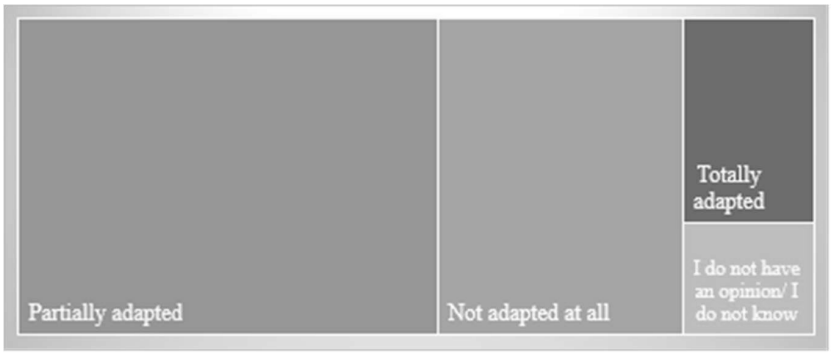
Figure 2: The perception regarding the implementation of the road and railway transport policies in the region



Source: authors, own interpretation

Concerning citizens' opinions regarding the implementation of the transport policy in the region once again the respondents have a better perception regarding the projects and measures related to the development of the road infrastructure compared with the ones related to the railway infrastructure. The results reveal uncertainty rather than a strong opinion. More citizens are satisfied with the measures implemented for improving the transport infrastructure rather than the disatisfied ones, but most of them do not have a clear opinion. The region has a ***Sustainable urban mobility plan*** based on the 2030 Agenda and the Green Deal (Bucharest Municipality, 2024). The plan comprises projects proposels that will contribute to the fulfilling of objectives such as: ***Development of local connectivity; Development of joint projects within territorial cooperation areas (peri-urban); Expansion and rehabilitation of utilities in peri-urban areas; Connecting the Bucharest green system with peri-urban areas; Increasing the accessibility of extra-urban cultural and recreational areas; Highlighting the capital's location in relation to major transcontinental corridors*** (Bucharest Municipality, 2024). There are ongoing projects that show that the transport policy in the region is implemented at a rapid pace even if the results are not perceived by citizens as they should be.

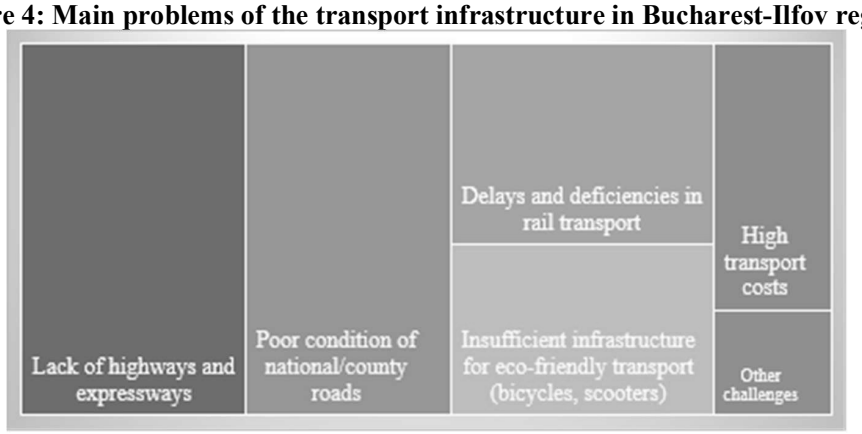
Figure 3: The perception regarding the adaptation of the transport infrastructure to the current needs of Bucharest-Ilfov residents



Source: authors, own interpretation

Then, respondents were asked if they consider that the transport infrastructure in the region (road, railway, subway, local transport) responds to citizens needs. Once again, the opinion is not positive but is better compared to the first questions. The participants in the study mostly consider that the infrastructure is only partially adapted to their needs and one third of them believe the infrastructure is not adapted at all. This perception could be due to the fact that the infrastructure does not respond to citizens' commute needs caused by frequent traffic jams, long periods spend in traffic, delays in the trains schedules or the overcrowding in the metro stations and trams.

Figure 4: Main problems of the transport infrastructure in Bucharest-Ilfov region



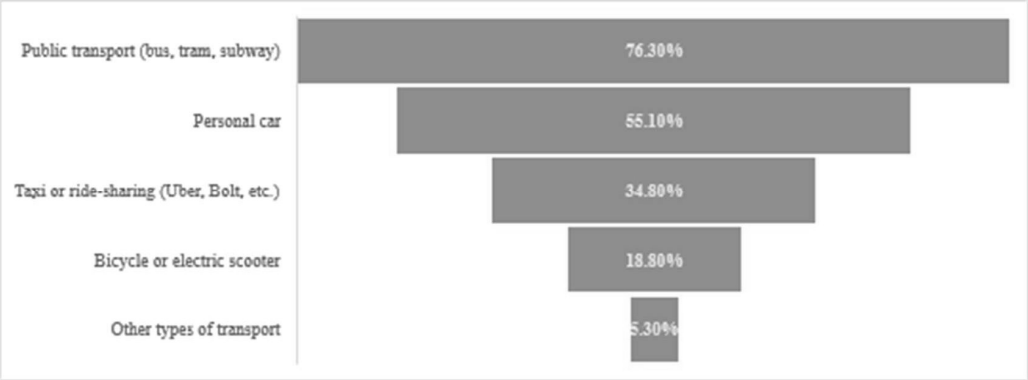
Source: authors, own interpretation

In order to understand the negative perception and to propose suited solutions for improving the transport infrastructure in a sustainable manner, the respondents were asked what are the main problems regarding transport in the region. On first place was the lack of highways and expressways followed by the poor state of the national and county roads crossing the region. Because the regions hosts the capital city there are three highways starting from Bucharest but it seems that the residents of the area consider that they need more highways. Also, the main problems is that the highways in these area are always crowded, especially the Sun Highway (A2) which leads to Constanța County, to the seaside. The response also is related to the state of the ring road which surrounds the capital and should help at decongesting the traffic. Another important problems are considered the delays and deficiencies of the rail transport which is problematic in the whole country and the insufficient conditions for means of transportation more fiendly with the environment such as bycicles.

Observing the results, it can be stated that the first hypothsis of the study validated: the transport infrastructure in the Bucharest-Ilfov region does not meet citizens' needs.

4.2. The local transport system in Bucharest-Ilfov region

Figure 5: The most used transportation means in Bucharest-Ilfov region



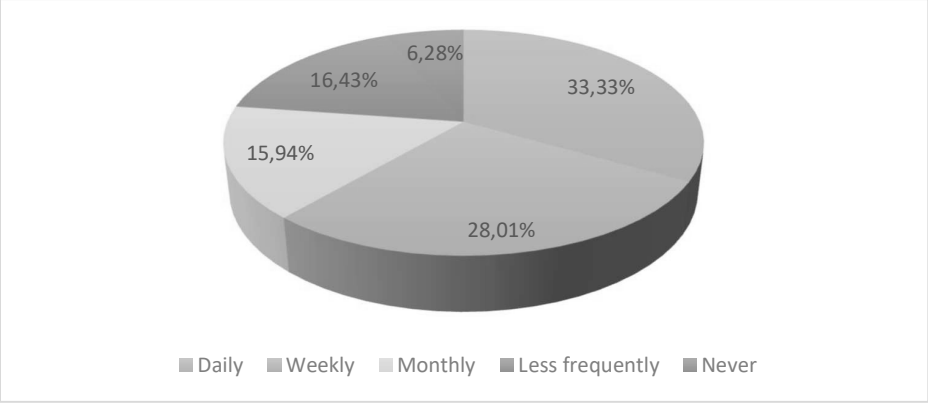
Source: authors, own interpretation

This part of the study is dedicated to different aspects regarding the public transport system. First, a hierarchy with the most used transportation means in the region was made. It is observed that on the first place is the public transport, followed by the personal car.

In Bucharest and its metropolitan area, transportation has become a strategic point of vulnerability within the broader framework of urban and regional development. Over the past years, the metropolitan region has experienced a notable increase in population density, primarily as a result of internal migration from the capital city to adjacent peri-urban zones. This demographic trend has generated a significant rise in demand for public transportation, particularly in suburban areas that often lack adequate infrastructure and service coverage. At the same time, private car usage continues to represent the second most prevalent mode of transport, contributing further to congestion, environmental degradation, and the overloading of an already insufficient road network.

The personal car is very used as a mean of communting, and even if the authorities promote the public transport, the reality shows its limitations and the fact that trams, buses and metros are overcrowded. It can be statead that especially in the capital, the public transport and the roads are used at their full pace. The authorities should find new solutions for reducing the time spent in trafic and to expand the public transport system.

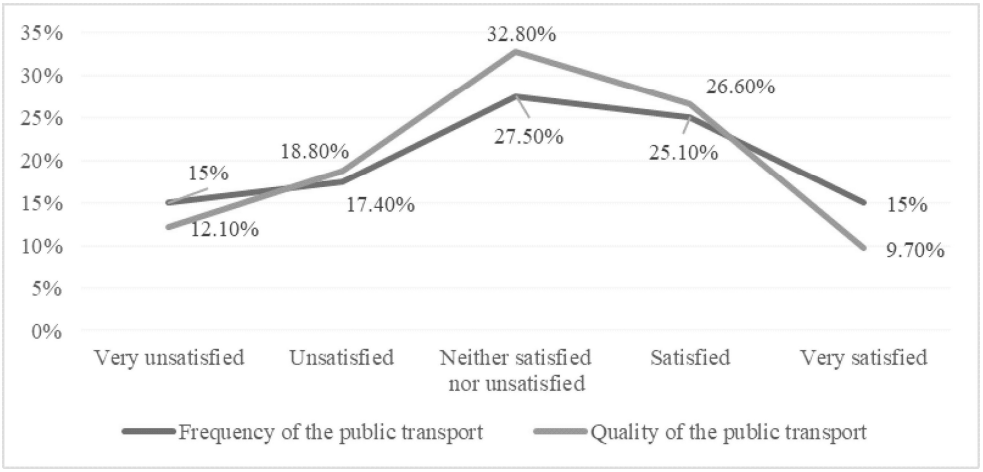
Figure 6: The frequency of usage of public transportation



Source: authors, own interpretation

The figure shows the frequency of using public transport by the respondents. One third of them use it daily and another third use it weekly. Only a small proportion use exclusively other means of transportation beside the public one.

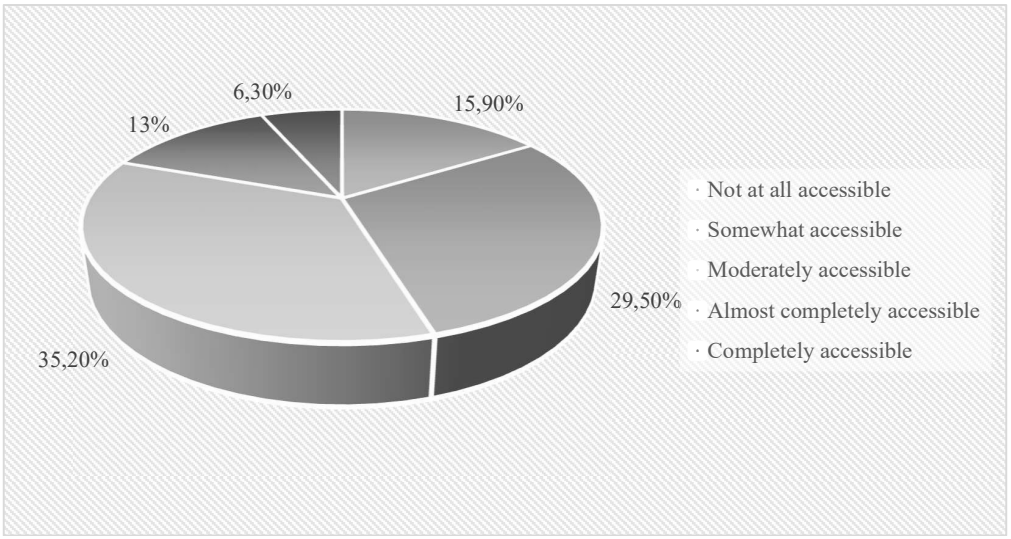
Figure 7: The satisfasfaction regarding the frequency and quality of the public transportation



Source: authors, own interpretation

Regarding the frequency and the quality of the public transport in the region, the responses are similar. Around one 30% of the respondents have a neutral opinion. Almost 40% declare themselves to be satisfied and very satisfied with these aspects, but still a pretty high proportion, around one third express a feeling of disatissfaction. The perception is better than the one related to the public infrastructure, but it shows again the need for appropriate measures in order to develop the public transport.

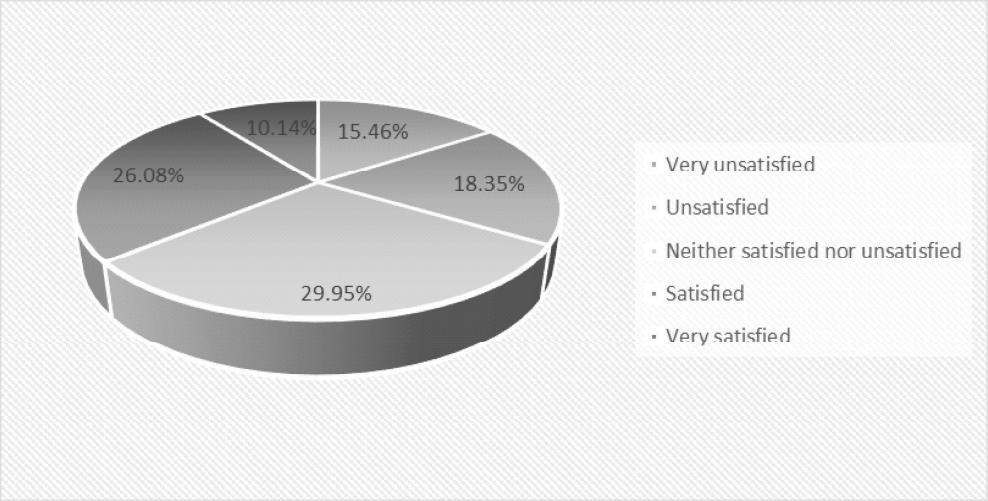
Figure 8: Assessment regarding the accesibility of public transport to disabled persons (cleanliness, comfort, safety)



Source: authors, own interpretation

A main problem in Romania is the access of disabled persons to the public transportation. In Bucharest most of the trams are old and inaccesible to disable persons. Most of the metro stations are accesible for people with disabilities, similarly, buses are equipped with ramps for people with disabilities. On a whole is quite difficult for a disabled person to use the public transport without help or even with the necessary help. The opinions of the respondents are divided between somewhat and moderately accesible.

Figure 9: The satisfaction regarding public transportation in Bucharest-Ilfov region



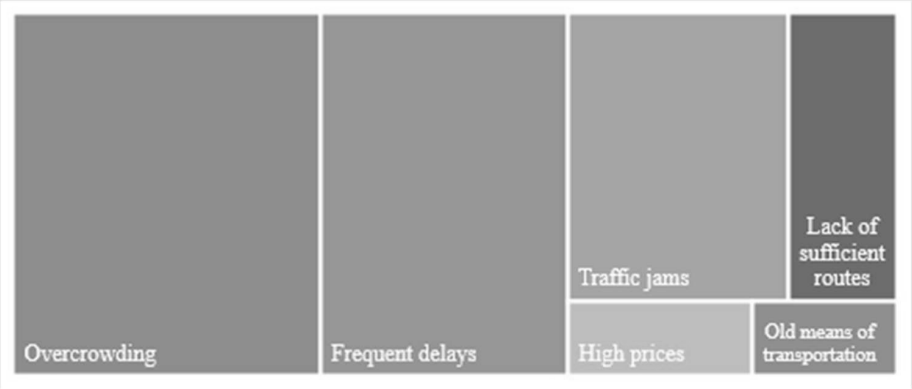
Source: authors, own interpretation

Concerning the general level of satisfaction with the public transport system in the region it is observed that the sample is divided clearly in three, as one third consider themselves to be satisfied, another third disatisfied and one third have a neutral opinion. The data on the question regarding the local transport in the region validate the second hypothesis: citizens' general level of satisfaction with public transport system in the region is low.

It is essential that both local and national authorities implement urgent and coordinated measures aimed at improving transport conditions, with a particular focus on infrastructure development and the modernization of the vehicle fleet. Such interventions are critical to enhancing the overall quality of mobility services and increasing citizen satisfaction.

4.3. Problems and solutions

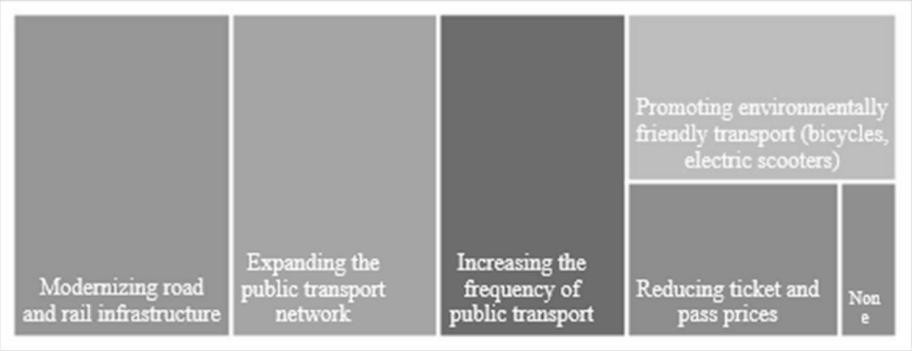
Figure 10: Main problems of the public transportation in Bucharest-Ilfov region



Source: authors, own interpretation

The last part of the research focused on identifying the main problems and proposing viable solutions that would lead to the development of urban mobility. The opinion of the respondents is that the most important problems in the area are the overcrowding, the frequent delays of the public transport and the traffic jams. Once again, the results show that the public transport infrastructure is insufficiently developed as to meet citizens' standards and needs. The results validate the last hypothesis of the study (H3: The main problems of the public transport system are traffic jams and overcrowding).

Figure 11: Proposed solutions for improving mobility in the Bucharest-Ilfov region in a sustainable manner



Source: authors, own interpretation

Regarding potential solutions for the development of a sustainable transport system, the results of the analysis reflect citizens' views that the top priorities should focus on improving both road and rail infrastructure. In the current context, the railway system is not widely used for daily commuting due to frequent delays, low travel speeds, and poor comfort conditions onboard trains. Consequently, investments in railway infrastructure are considered essential for enhancing the sustainability of the transport system.

A second proposed measure involves the expansion of the public transport network. Compared to other European capitals, Bucharest faces significant challenges due to the lack of well-integrated transport hubs that connect trains, trams, buses, and the metro. Furthermore, the need to increase the frequency of public transport services is highlighted, particularly for trams and the metro, where during peak hours the number of available vehicles remains insufficient relative to population demand.

Other advanced solutions include promoting the use of alternative modes of transport, such as bicycles. However, this approach remains debatable given the city's large size and the long distances typically traveled by commuters. Additionally, reducing ticket fares is perceived as a beneficial measure. Nonetheless, over the past two years, the trend has moved in the opposite direction, with rising prices for train, bus, tram, and metro services, which further complicates efforts to make public transportation more affordable and accessible.

5. Discussions and recommandations for improving urban mobility and promote a more sustainable transport system

Transport is a strategic issue with multiple connections and interactions in various fields. High-quality transport means a developed economy, high mobility, a protected environment, and satisfied citizens. In the past few years, european governments have put a lot of money into recovery and resilience plans for 2021-2027 and into transport programs to make big investments in all types of transport. As an EU member state, Romania needs massive investments in transport infrastructure and the acquisition of means of transport that meet both comfort and environmental requirements. In recent years, the Romanian government has often referred to transport as a priority 0.

The Bucharest-Ilfov area is the most important economic center and the largest population center in Romania, and in terms of transport, it is the most important rail and road hub.

The analysis highlights the need for the strategic implementation of sustainable transport solutions that promote environmentally friendly mobility, reduce greenhouse gas emissions, and ease traffic congestion. Furthermore, in the context of the accelerated urbanisation of the Bucharest-Ilfov region, the development of a sustainable transport system is becoming a key factor in ensuring balanced, resilient and environmentally friendly urban growth. An important aspect is the lack of effective coordination between all the authorities involved and overcoming these obstacles, which constitute major barriers to successful implementation. The promotion of sustainable transport in the Bucharest-Ilfov region is a pressing necessity, and it is imperative to adopt concerted and sustainable measures at local and regional level.

6. Acknowledgement

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