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Article

New trends searching for urban transport management in the context of the regional development of Stara Zagora municipality

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Abstract: The paper proposes a methodology for the analysis and evaluation of the traffic scheme of Bulgarian cities. The authors combine spatial, network, and socio-economic analyses of cities with transport operators' financial-economic evaluation, sociological studies of transport habits, and the possibilities of new information technologies for transport modeling (such as geographic information systems). The model proposes several approaches to optimize the municipality's transport scheme. It results from a new need to improve urban traffic, the quality of transport services, and the integration of urban transport into the regional economy of Stara Zagora municipality. It presents a description, analysis, and outline of the opportunities for developing urban transport connectivity and mobility in Stara Zagora municipality. The research results show a deficit of transport connectivity between the different parts of the city, reflecting on the regional economy's development and the efficiency of the environment and the population.

Keywords: regional development; municipalities; urban mobility; public urban transport; transport modeling

1. Introduction

In the twenty-first century, we are witnessing a new type of economy leading to a rapid transformation of technology and accelerating changes in the economic environment. It is characterized by business models that are more dynamic and agile than ever before. This stage or new phase has come to be called Economy 4.0, also known as the sharing or concentration economy. Business models are evolving for the communications, media, and technology (CMT) industry in addition to the tertiary sector, and companies are looking to seize new opportunities and innovate to keep pace with the changes ahead. This process also affects the public sector, where transport services in urbanized systems are structured (Kolasińska-Morawska et al., 2019; Lom et al., 2016). This gives rise to the need for several innovations in the transport system ranging from the formation of new development strategies, route optimization, traffic management, the creation of a reliable information environment for travelers, and several other activities that need planning of the activities related to transport management. Thus, when assessing and analyzing transport management, organizations need to consider how to proactively manage the emerging and dynamic risks arising from this new economic and digital era. This aspect is linked to the risk management that these companies must consider and anticipate the impact the assessment will have on the administrative-territorial unit in which they provide the relevant transport service. In addition, it is found that it is necessary to look for opportunities for the public sector to generate efforts to meet the requirements of green

transition and Economy 5.0 without having exhausted the possible options for conducting a quality transport policy. The latest innovative solutions are linked to new environmental standards that provoke the search for new solutions for transport development (Rosemann et al., 2021; So et al., 2019).

The development of urbanization processes and population movement has led to new dynamics in transport systems in recent years, which require new technologies to improve urban mobility. This implies significant technical, organizational, and spatial changes to improve the efficiency of mass public transport and conditions for transport infrastructure development (Gnap et al., 2023). In recent years, urban transport in Bulgaria has faced the need for change to improve its efficiency and cost-effectiveness. In practice, the transport system is constantly evolving, driven by the requirement to achieve a sustainable urban environment, and accessible and environmentally friendly transport. The development of transport schemes in Bulgarian cities began in the 1970s (Pucher and Buehler, 2005; Petkov, 2020; Slaev and Nikiforov, 2013). The development of urban transport systems in Bulgarian cities is simultaneously occurring with the urbanization and spatial development of urban centers in Bulgaria. For various reasons, the established public transport systems in Bulgaria for a long time did not correspond to the times and the new conditions, especially in terms of the country's membership in the European Union, a purposeful change started. Integrating intelligent management systems and information technologies into urban transport systems has started (Todorova, 2015). Observations show that Bulgarian cities started mass public transport systems optimization in the last decade. Based on the transport analysis, the need for city transport integration, smart management, and spatial city development the local authorities started the transport optimization. As a result of this process, some cities' authorities have begun the updating and transport scheme changes. The city transport optimization was conducted solely in major regional centers such as Sofia, Ruse, Varna, Burgas, Plovdiv, and Stara Zagora (Assenova, 2023; Kovachev et al., 2018; Madzhirski and Dimitrova, 2019; Pencheva et al., 2018; Pencheva et al., 2020). Here is the place to focus our research on the search for new trends in urban transport management in the context of the regional development of Stara Zagora municipality. The example of Stara Zagora is important because as an administrative-territorial unit, it combines a city and 52 other settlements in which transport connectivity is essential for the socio-economic development of the municipality. It is important to note that the Maritsa East energy complex, the military factories around Kazanlak, and the developing agricultural sector need the labor resources of Stara Zagora municipality, which implies daily labor migrations and the importance of transport for the working population. At the same time, the city of Stara Zagora is an important educational and administrative center, which concentrates on the city's young population to acquire secondary and higher education and a bureaucracy with a high level of education. At the same time, the change in the regional economy since 2007 has brought new investments and changes in urban relations in the municipality of Stara Zagora, which makes it necessary to look for new optimal solutions for the transportation of labor resources in a way that is economically viable and prestigious for the citizens.

On the other hand, Bulgarian cities and respectively city transport are influenced by fast urbanization, smart transition, technical vehicle changes, agglomeration

formation, and new energy sources. In this context, it is incumbent upon the city transport and management authorities to address these requirements (in particular, the 5G network and IoT, smart management and intelligent systems, ecological standards, and others) and to adapt. This process requires a new methodological framework to be developed to assess and improve the transport scheme of the cities, based on detailed studies and analyses that will be carried out.

2. Materials and methods

The authors integrate cities' spatial, network, and socio-economic analyses with financial and economic evaluation of transport operators, sociological studies of transport habits, and the possibilities of new information technologies for transport modeling. This is an exemplary approach. In addition, the methodological framework is completed with GIS and gravity model application. The data is reliable and correct which is guaranteed by information sources. The authors gather the data from Stara Zagora municipality, the National Statistical Institute, the city transport company, and their terrain survey.

The study methodology combination of statistical, geographical, sociological, political, and economic methods brings to the fore the interdisciplinary approach. This integration of methods motivates us to draw a more comprehensive picture of the transport potential of Stara Zagora. Consequently, the concentration of public transport infrastructure within a municipality and the regional economic importance of such services provide a basis for identifying pertinent issues and the necessity for new policy formulation. Another important methodological approach is the geo-economic assessment, which is based on the analysis of urban transport needs by applying a network approach, a balanced method, and digital modeling, as well as the application of geographic information systems (Loidl et al., 2016). This approach enables the inference of the gravity zone and the efficiency of public transport in territorial connectivity, as demonstrated by Gonzalez-Calderon et al. (2009).

In the research, the authors aim to identify new opportunities for urban transport management improvement within the context of Stara Zagora municipality regional development. In particular, it examines emerging trends. Thus, the main objective of our research is to be as objective as possible to reduce biased interpretations of the results. Another main purpose is to document, archive, and share all the results and methods to show the need for a new spatial model of urban transport structuring based on the results of a representative survey conducted with 1024 respondents from different age groups and the municipality territory by the method of questionnaire completion and individual interview.

- The main objectives of the sociological research are:
    - To identify the associations that arise in the minds of consumers regarding public transport in Stara Zagora;
    - To study the opinions and attitudes towards public transport in the city;
    - To identify the occasions and frequency of use;
    - To identify and evaluate the factors influencing customer satisfaction and overall customer satisfaction;
    - To identify unmet customer needs;

- To identify the profile of public transport users in the city of Stara Zagora;
- To generate recommendations for optimizing and improving key features of public transport.

- The methodology of the sociological survey is as follows:
  - Type of research—quantitative;
  - Data collection method—Structured interviews (face-to-face);
  - Target group—Residents of Stara Zagora who use public transport;
  - Type and size of sample—Stratified sample according to districts of Stara Zagora. The sample is distributed proportionally according to the district size and residents' age structure. The respondents are of different social statuses, professions, and education;
  - Sample size: n = 1000 (max. st. error +/−3.2%)
  - Coverage—City of Stara Zagora;
  - Fieldwork control—Logistical control of 100% of the sample; telephone control of 10% of the sample.

Based on the sequence of actions and measures that illustrate the functionality of transport, we can also derive the possibilities for optimization of public transport, as well as the possibility of improving its condition and the opportunity for development. The sequential focus of the work shows that a new model of transport connectivity can be realized through the prism of urban development, especially as an upgrade of the existing transport system. The advancement of the transportation system has the potential to address pressing issues and address deficiencies in the density of the transportation network, as well as to extend the service area. The development of the transport system can address pressing issues and address deficiencies in the density of the transport network, as well as expand the service area. A further set of issues to be addressed is purely environmental. The green policies implementation and activities related to the municipality or region preservation must address transport problems within the Stara Zagora municipality. This requires an interdisciplinary approach use.

The gravity model can be represented by the following equation:

$$M_{ij} = P_i P_j / d_{ij}^2 \quad (1)$$

where:

M_{ij} is the amount of movement between i and j;

P_i is the population of settlement i;

P_j is the population of settlement j;

did is the distance between the two settlements I and J (Ismael and Waheed, 2018)

The interaction M_{ij} can be the number of settlers, the volume of goods transported, the number of letters or telephone calls, etc. The distance can be measured in various ways, including in kilometers (miles) or transportation costs. More complex models consider certain population characteristics of the two settlements, expressed by appropriate weighting factors.

The research methods also include the collection of available graphic and textual material; systematization of the collected information on the urban and communication-transport plan of Stara Zagora; diachronic analysis of the urban and transport evolution of the municipality; graphic analysis of the urban and communication-transport plan and map of Stara Zagora, and comparison of the

planned with the degree of realization.

Based on the research results the authors will analyze, evaluate, and compare with expert assessments and other analytical results and draw the main conclusions. At the final stage of the research, the author will outline new trends and propose changes that will positively affect the development and management of urban transport. The study results can be applied in other major cities by their geographical, demographic, natural, and territorial specificities. The scientific method is often presented as a fixed sequence of steps specified as general principles. In practice, we will outline the trends and the need for the development of public transport in the municipality of Stara Zagora. On the other hand, the presence of an industrial base also brings to the fore the state of factory transport of economically active people, the importance of private transport in urbanized areas, and the possibilities of staying and parking in these dynamic parts of the city. The main approach is to capture those trends that can make public transport more frequently used by citizens and increase the prestige of using public transport. The assessment, findings, and analysis are the fruit of the expert potential of the research team and the experience gained in assessing the functional state of urban transport in settlements of the rank of Stara Zagora municipality. In this study, by "transport optimization", we will understand a series of complex activities that lead to the improvement of the operation of urban transport to limit the losses and negative results to a minimum in the implementation of the activity of the economically active entity and at the same time improve its efficiency. The optimization process is related to the congestion capacity, throughput, and governance requirements of public transport. The authors use the term 'urban mobility" in the context of the services provision and policies by the public sector to citizens to create conditions to facilitate citizens' travel. We must be aware that travel in the urban system involves all citizens because it is an expert estimate that every urban dweller walks at least 5 km a day, which means that almost every citizen uses public transport. Demography also examines the processes of daily labor migration, which mainly involves people of working age who travel up to 100 km daily to work in various economically active persons or public institutions. More than 30 thousand people in Bulgaria require city transport use. In practice, the municipality of Stara Zagora includes nearly 170 thousand people. The forms, techniques, and methods of scientific inquiry represent the logical processes carried out by the researcher for problem-solving. These activities are usual for people in their daily lives, but their role in science is significant, for solving problems and publishing scientific advances.

At the beginning of any study, an important process is data collecting, and processing for posing the problems and solving them adequately. In our case, the activities related to providing the necessary information are aimed at analyzing the existing base of strategic and normative documents, the socioeconomic and demographic development of the municipality, and the state of transport in Stara Zagora. Given the sequence of scientifically based and practical actions thus indicated, several main stages in the research can be identified.

An important part of the initial analysis is the municipal urban transport enterprise financial and economic indicators evaluation (Ibarra-Royas et al., 2015). The formation of an expert assessment means the evaluation and analysis of the socio-economic situation of Stara Zagora Municipality, the review illustrating data on the

city's population and growth projections, economic activities, urban regulation, and expected development that may affect urban transport, the distribution of transport by mode, transport trends in Stara Zagora Municipality and other relevant information, all of which will be quantified with the greatest possible degree of specificity (Litman, 2022). The third stage of the study includes an assessment of the financial and economic situation of the public transport operator, an analysis of the existing transport scheme of the city, and an analysis of the existing transport lines. The fourth stage covers transport modeling and optimization of the public mass transport system in Stara Zagora municipality (Ranjan Samal et al., 2022). An important aspect of data collection is a sociological survey, which should establish the attitudes of the population in Stara Zagora about possible changes to the transport scheme, transport habits, problems, quality of transport service, recommendations, time, and purpose of trips, etc. The required information also includes urban traffic congestion, the density of commuters in different parts of the city, congestion of individual urban and suburban lines, bus stops, and other important information related to passenger flow and urban traffic.

3. Results and discussion

The results of the applied methodology related to urban transport optimization in Stara Zagora revealed the need for a new transport planning paradigm (Schiller and Kenworthy, 2018). In this direction, the transport modeling in Stara Zagora outlined the possibilities for implementing sustainable urban transport policies that ensure accessibility to the main destinations and services in the city. The approach used is controversial. The authors analyze interesting and original ways of analyzing and evaluating the transport system, such as multi-criteria and multi-objective approaches (Stoilova, 2020; Stoilova and Nikolova, 2016). The authors also carefully analyze Assenova's methodology for changing urban transport routes (Assenova, 2023). At the same time, the appliance of the tools for transportation geography analysis in Stara Zagora is an effective method for the assessment of the movement of people (Cidell, 2021). In this direction, the obtained data on people's transport in the city guided the authors to the main directions for changes in the transport scheme. this analysis was complemented with an assessment of the quality of the transport service. In this way, the authors prove the effectiveness of applying tools to measure the transport service and its quality (De Oña et al., 2015). According to the authors, the transport scheme optimization must be implemented with measures for sustainable and environmentally friendly urban transport. These measurements are related to the just transition and carbon emissions decreasing. This relationship is explained in great detail in the scientific literature on the subject (Sładkowski, 2020).

The research results require transport management changes. Based on the results the authors propose their approach to improving urban transport management. New solutions often have to consider urbanization processes and the deconcentration of urban systems through satellite settlement construction. This also sets new priorities and the necessity for combined transport introduction (underground, air, and linear) in urbanized systems. Thus, in developing urbanized systems, especially in Stara Zagora, there is a need for electric buses to transport passengers within the city and between

urbanized areas, using suitable older vehicles. However, questions about the quality of the service provided, the financial efficiency, and the sustainability of the proposed changes remain open due to the state of human resources in the urban transport system, as well as the need for rational planning and efficiency of public transport management in the municipality of Stara Zagora.

The analysis reveals some mobility and traffic problems related to city transport. These issues are fundamental for Bulgarian city transport development and are proved in other publications in Bulgarian scientific literature (Pencheva et al., 2018). The case of Stara Zagora shows that the main issues are bus line duplication, city transport attraction absence, transport services quality improvement, city traffic, and transport access and mobility. The tasks we set ourselves are to analyze and evaluate the transport system and to derive mechanisms and activities that lead to improving the economic efficiency of transport an important task is to propose a transport model that increases connectivity and the quality of transport services. It is also necessary to draw conclusions and assess the future rate of regional development of the municipality of Stara Zagora, which will undoubtedly impact the need for public transport development. The proposed approach for transport connectivity in Stara Zagora municipality is based on the analysis and assessment of the transport system, outlining an optimized transport system that improves passenger flow and the economic efficiency of transport (McNally, 2000). Of course, the developed methodology is based on existing regional development planning and transport modeling practices (Stead and Pojani, 2017). It allows us to consider the principles of regional integration, economic feasibility, and development within municipalities from the level of Stara Zagora to meet the mobility needs of people in the present and future.

4. Discussion

4.1. Focus on public attitudes towards public transport in Stara Zagora

Spatial planning and management is a complex process linked to spatial development. In practice, we consider the municipality of Stara Zagora as one of the municipalities in Bulgaria that both attracts a new population and faces the emigration of a significant part of the young population. Stara Zagora Municipality occupies an area of 1019.4 km^2 and is in south-central Bulgaria, on the southern slopes of the Sarnen Sredna Gora Mountain in the Stara Zagora field. The town has important natural-geographical and economic significance for the region and the country (Wilinski and Pathak, 2022). The city's economic, transport, communication, administrative, scientific, cultural, educational, commercial, health and other features impact the dynamics and development of the municipality and the overall development of the Stara Zagora region and the South-East Planning Region. This location has its own optimization needs. However, from a regional economic point of view, functional models have been developed, which are defined by the relationship between housing—jobs—public administration—economic activity—and other housing linked by public transport. This influences our research framework, which shows that regional economic development is related to the spatial interaction most easily achieved by public transport. This defines our research framework, which shows that regional economic development is linked to interactions in the spatial environment most easily

facilitated by public transport.

The public transport for passenger transport in Stara Zagora is represented by two types of transport—bus and trolleybus. As we see in **Figure 1** transport scheme consists of the bus routes of two types—purely urban lines and those serving the city and nearby settlements respectively (**Figure 1**). According to the city transport company data analysis trolleybus lines serve only the urban part. The data analysis reveals that buses carry 75% of the passengers on public transport and trolleybuses the remaining 25%. The number of bus lines is 38 together with inter-urban lines, including main urban lines 12. Between 11% and 15% of the population of Stara Zagora benefit from the public mass transport system in the municipality. Important determinants in the analysis of public transport are the existing three bus stations in the center, east, and west of the city. Currently, only the central bus station is used.

Figure 1. Transport scheme of Stara Zagora municipality (Source: Stara Zagora municipality).

Public transport plays an increasingly important role in today's urbanized environment and there is a constant need for partial changes, adjustments, and innovations. To clarify the citizens' transport attitude and habits assessment in Stara Zagora, a sociological survey was conducted among 1040 citizens. The study aimed: to identify the associations that arise in the consumer consciousness regarding public transport in the city of Stara Zagora; to study the opinions and attitudes towards public transport in the city; to identify the occasions and frequency of use; to identify the profile of public transport commuters; and to generate recommendations for optimization and improvements on key characteristics of public transport. The main occasions are commuting to work (26%), meetings with family, friends, and relatives (24%), and walks and entertainment (21%). Among the older population, shopping is also the leading occasion. In practice, there is considerable satisfaction with transport in the population. The results show that nearly 89% of residents are fairly satisfied with public transportation services. The best indicators (with the highest satisfaction) are Travel Time (93% satisfaction), Winter Heating (91%), and Information Signs (90%). On the other hand, the population expresses that travel options are limited due to the high cost of tickets. Citizens express the most dissatisfaction regarding the price of tickets (47% dissatisfaction), The price of monthly passes (34%), the number of places selling season tickets (28%), and waiting conditions at bus stops (21%) are also important. Along these lines, nearly 37% of citizens believe that among the most important improvements for public transport is to make the fare more affordable, and

26% of citizens would like to see more affordable options for monthly passes. An important observation is that young people under 30 and pensioners are the most price-sensitive.

Although the citizens who use public transport are satisfied with the service, it should be stressed that public transport is mainly used by the older and younger generations of Stara Zagora. Therefore, it is important to find out what would make public transport attractive to the working population, which is the majority of the city's inhabitants. This would also solve the problem of traffic and congestion.

It is interesting to note that most residents (49%) of Stara Zagora use public transport, 23% use private cars, another 23% walk and 4% use bicycles (**Figure 2**). The results show that 50% of the city's inhabitants are targeted by a new transport policy to motivate them and create the right conditions for them to use public transport.

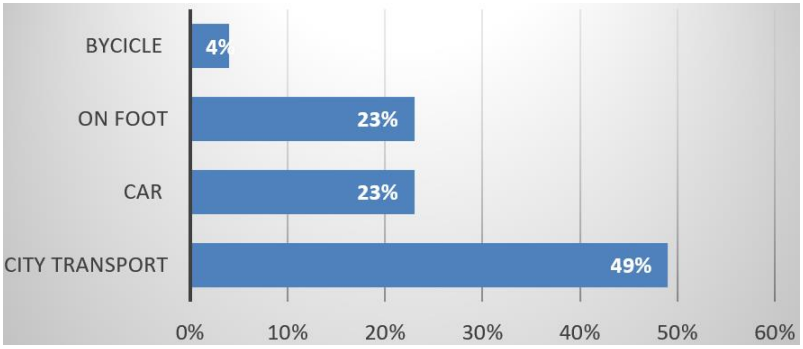

Figure 2. Which of the following ways of getting around in Stara Zagora do you usually use in your daily life?
Source: Own sociological research.

Along with the above findings, other problem points such as regularity, bus stop facilities, and staff courtesy also come to the fore. The regularity of buses and trolleybuses is an important point for the use of public transport. A significant number of citizens (over 70% of respondents) find that, especially at late hours or on weekends, public transport is irregular. They report a clustering of several bus lines one after another and long periods without any passing lines after that. Waiting for conditions at bus stops is also a frequently mentioned problem, especially bus shelters, which residents say are non-functional and fail to protect those waiting from rain, wind, and snow. 22% feel that among the most important improvements are repairing and replacing these facilities so that they are functional. There are also complaints about the courtesy and responsiveness of controllers and drivers, as well as ticket machines that do not give change.

Figure 3 shows how often people in Stara Zagora use public transport. Only about 30% use public transport every day. Another 23% use public transport in the city several times a week. The rest use it rarely. These results show that there is not enough consistent passenger flow to generate revenue. Observations show that the current transport system does not provide comprehensive urban accessibility. For example, new neighborhoods that have been built are not served by public transport.

In recent years, most urban construction and development has taken place on the periphery. This has led to citizen assessment that more lines and stops are needed on the periphery of the city. Thus, in this direction, we can assume the opinion of about

30% of citizens who believe that bus and trolley routes in the peripheral neighborhoods of the city are insufficient. Many residents complain about the lack of direct routes from their neighborhoods to key points for them (e.g., train and bus stations, Ayazmo, University/St. Urban, and other neighborhoods), which in turn requires transfers and doubles the trip final cost.

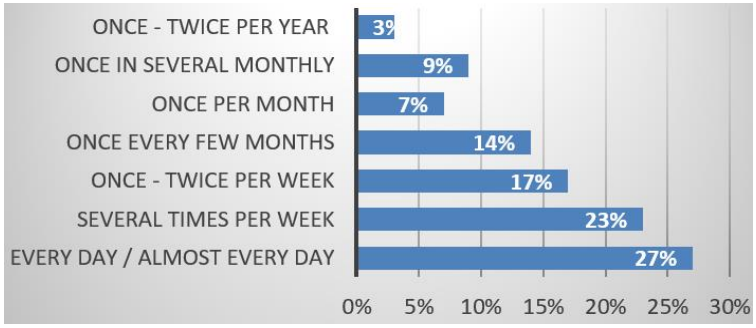

Figure 3. How often do you use public transport in Stara Zagora?
Source: Own sociological research.

4.2. Analysis of the passenger traffic

The public transport system in Stara Zagora municipality is divided into urban and inter-village lines. Public transport in Stara Zagora includes two types of vehicles trolleybuses (which have been analyzed in detail above) and bus transport, which will be analyzed here. For the analysis carried out by the procurement team, the bus lines were monitored during one of the busiest months for public transport, namely May. A data collection, processing, and analysis procedure was implemented for bus and trolley lines, and urban and intercity lines in the municipality of Stara Zagora. As is illustrated in **Figure 4** there is a clear distinction between those that serve urban areas and those that connect villages to the city. Although there is peripheral urbanization in the villages, this process cannot compensate for the number of passengers needed to ensure the viability of inter-village urban transport. We observe that the busiest routes are 51, 64, and 20. Line 51 achieved a passenger load of almost 1600 people on 9 May (Monday). The least busy lines are the intercity lines, although there is a convention. The heterogeneous character of the bus services to the villages is a contributing factor. These services can be classified as both interurban and urban. It is noticeable that the greater flow of people is within the city. However, the continuation of the lines into the city is duplicated by the other city lines on the other side.

The passenger load depends on the year season, tickets' price, economic activities level in the city, transport habits, city transport organization, fuel expenditures, and public transport timetables. The observed ridership is for May, one of the busiest months of the year. The data is gathered according to the active not active seasons of the year. The busiest months are March, April, May, September, October, November and December. The least busy months are January, February, June, July, August, and September. Passenger data is collected from the transport company on tickets sold and card validations on individual journeys.

Figure 4. City transport scheme.

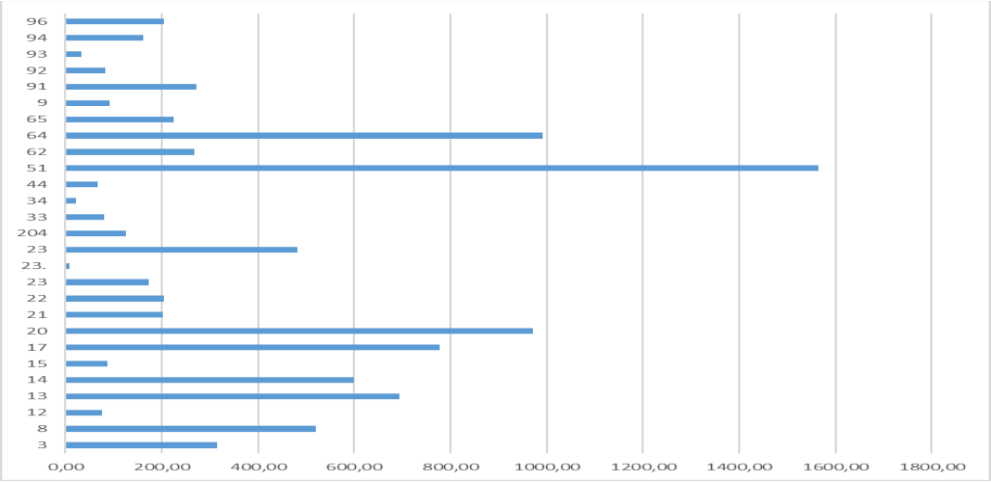

Figure 5. Bus line occupancy based on tickets sold for 9 may 2022.

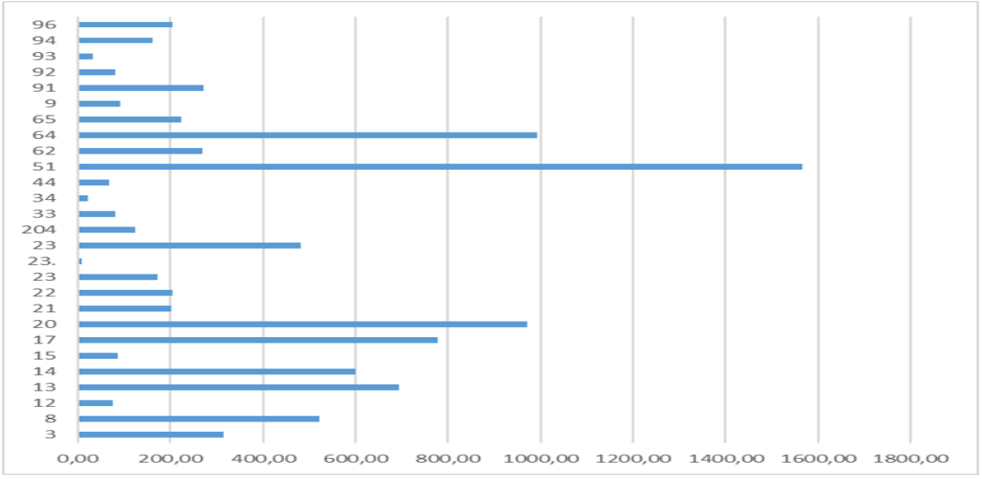

Figure 6. Bus route occupancy based on daily validations for 9 May 2022.

Figures 5 and **6** show sold tickets and validations on 9 May. The picture is

slightly different (**Figures 5** and **6**). As we can see from the graph that follows bus lines 13, 2, and 36 have the most validations. Lines 14, 17, 20, 26, 3, 36, 51, 64, and 8 also have relatively good ridership with potential for development.

On the other observed date, 13 May 2022, we see an almost identical picture (**Figure 7**). With 1200 tickets sold, line 51 stands out in first place. The next busiest line is number 13 with around 1000 tickets sold. Almost on a par are numbers 3 and 64, followed by numbers 8, 14, 17, 20. And in the next group are lines 15, 21, 22, 23, 34, 62, 91, 94 and 96, which are in the range of 200–300 tickets sold (passengers). There are also lines that are negligible in terms of passenger numbers.

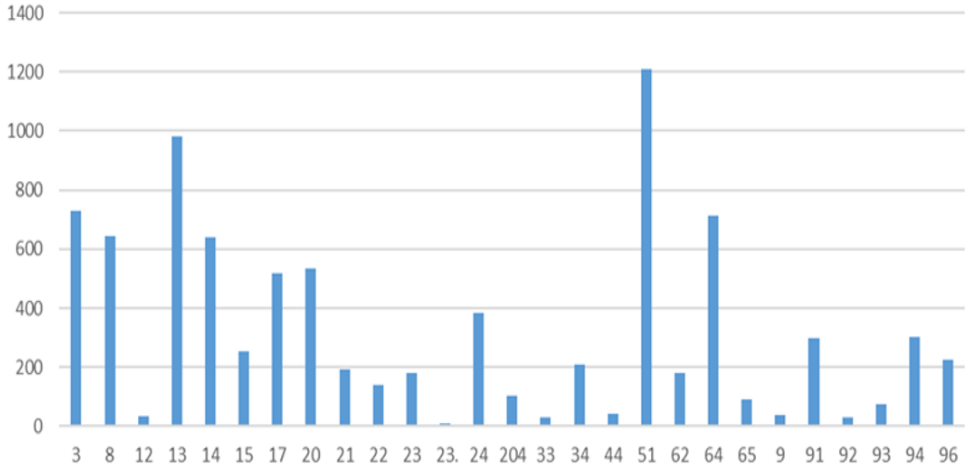

Figure 7. Bus route occupancy based on tickets sold for 13 May 2022.

In **Figure 8** we can see that, based on electronic validations, the number of passengers is highest for bus line 36 (about 1700 validations). This is followed by lines 13 and 2 with almost 1400 and 1200 validations respectively. The other group is made up of lines 14 (800), 17 (just over 600), 26 (800), 3 (just under 800), 51 (around 1000), 64 (around 500), and 8 (around 700). The last group includes the bus lines with validations in the range of 100–300. These are lines 12, 15, 17, 204, 21, 22, 23, 24, 33, 34, 44, 62, 65, 9, 91, 92, 93, 94 and 96.

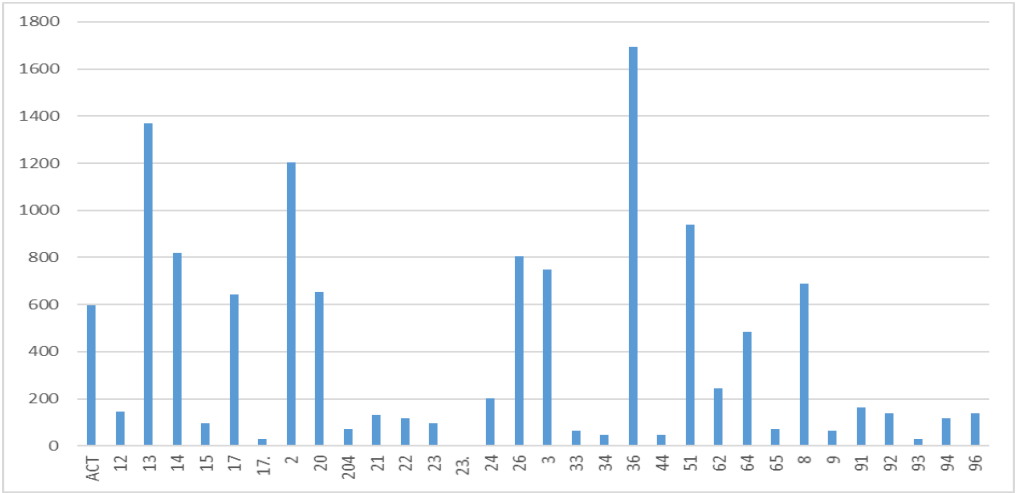

Figure 8. Bus route occupancy based on validations for 13 May 2022.

Figure 9 shows the average daily load of the individual bus lines. Two bus lines stand out. These are lines 13 and 51 with more than 2000 passengers. This first group of bus lines is busier. Number 51 is followed by bus lines 3, 8, 14, 20, and 64 with passenger load between 1000 and 1500 passengers. In this group, we have a good load factor. These are lines with potential.

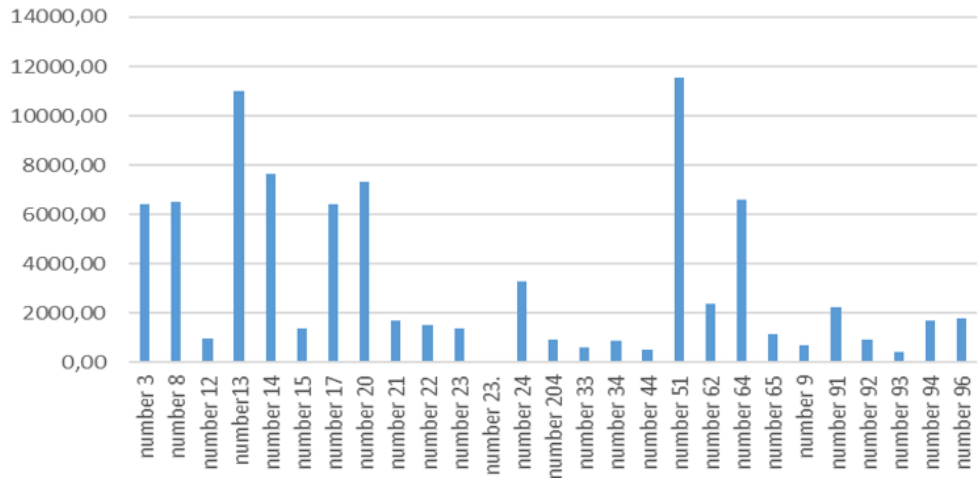

Figure 9. Average weekly load in an active season of public transport (Source: Own sociological research).

When analyzing the average daily passenger numbers of individual bus routes, two bus routes stand out. These are lines 13 and 51 with more than 2000 passengers. This first group of bus lines is very busy. This is followed by bus lines 3, 8, 14, 20 and 64 with between 1000 and 1500 passengers. In this group we have a good load factor. These are lines with potential.

The third group of lines is in the 300–600 range. This group of lines needs further analysis. It includes lines 24, 62, 91, 94 and 96. And the fourth and last group are the lightly used bus lines. These are lines 12, 15, 21, 22, 23, 23., 204, 33, 34, 44, 65, 9, 92, 93.

Figure 9 shows the average weekly occupancy of public transport in the municipality of Stara Zagora during the active season. Again, it is clear from the graph that several lines are the busiest. These are bus lines 3, 8, 14, 17, 20, and 64, which have a passenger flow of more than 5000 persons. Two are very busy 13 and 51 (over 10,000 passengers).

After the analysis, it is clear that the three trolleybus lines and 6 bus lines (urban) are the most heavily loaded with passengers, which means they are profitable. These are trolley bus lines 2, 36 and 26 and bus lines 13, 14, 20, 3, 51 and 8. The analysis shows that the urban lines are economically viable and can be upgraded. This analysis addresses the change needed in the intercity lines towards reducing them and shortening the distance. This can be done by connecting these lines with the urban lines at the regional bus stations of Stara Zagora municipality. This will solve the existing problem of duplication of bus lines in the urban part of the municipality.

4.3. Evaluation of financial and economic analysis of the municipal transport company

In the municipality of Stara Zagora, the transport service is provided by a public joint stock company owned by the municipality of Stara Zagora. Assessment and analysis are also subject to the existing municipal road network, the developed route schemes, the multiplicity of the inter-urban transport courses, and the time required to travel the distance between the settlements. This is how the individual characteristics of transport accessibility for citizens living outside the municipal center are formed and the financial framework of each line of urban transport is visible. A general assessment of individual lines and costs may have a different dimension, but this may lead to the need to conduct a social policy toward certain sections of the population within the municipality. It is important to specify that the financial results are the visible results of the company's main accounting data -revenue, expense, and profit and the main balance sheet data assets, liabilities, and equity. In this respect, our main focus will be on the company liquidity, profitability, and financial sustainability of the under consideration. In the Bulgarian context, public companies are subsidized by the municipality and the state for several reasons to fulfill their social obligations to society related to passenger transport. In this case, our task is only to show the trends in the development of this public company and to see whether it can develop sustainably given the complex situation of aging staff, overtime, relatively low employee pay, and other social deficits that are essential in the conduct of transport policy within a municipality. The situation of this public company is thus important in terms of the activities it carries out. The survey among the Public Transport employees shows that the company has more than sufficient capacity to carry out activities and planning effectively. The main direction in which the company should focus is to achieve good financial management with corresponding economic benefits from its activities, secondly compliance with timetables, and raising the prestige of the public transport commuter. An overall view of the financial management shows that funds are properly spent according to the requirements of the sub-regulations, that depreciation funds are generated, and that satisfactory savings in vehicle operating costs and emissions savings have been achieved. The company's revenue for 2022 amounts to 6,092,004 euros and in 2020 to 5,420,548 euros. Accordingly, this represents a 14% increase in revenue for 2022. This increase in revenue is mainly due to financing, which has increased by €656,837. The growth in service revenue is marginal (€102,331 or 4%).

It is important to note that the company in the two years under review the value of expenses exceeded the value of revenues. This indicates that to implement municipal policies it is in effect being up-funded. The total expenditure increased at a slower rate compared to the increase in revenue. The total value of expenditure in 2020 is 11,984,000 euro and that in 2021 is 6,617,776 euro (**Figure 10**). Accordingly, the increment is 576,686 euro (10%). The value of the expenses is formed by the expenditure for the operating activity—6614 euro, while the financial expenditures are only −3024 euro. The profit analysis of the company is a function of the P&L analysis. In both the years under consideration, the company recorded an accounting loss. In 2020 the loss is 618,022 euro and in 2021 the loss is 522,747 euro (**Figure 11**). A

reduction in the loss of 94,770 euros, or a decrease of 15%, is identified. The loss reduction is due to a faster revenue increase than expenditure. However, it is not sufficient for the company to turn a profit. The analysis of operating profit deserves further attention as revenue is reduced by the amount of financing. Thus, the financial result is solely based on revenue from (transport services provided). The value of the operating loss excluding the revenue from subsidies is 3,927,414 euros for 2020 and 4,401,265 euros for 2021 (**Figure 12**). This is evidence of the huge role of funding in reducing profit. However, even financing is not conducive to the company turning a profit. In addition, a single-member limited company can operate autonomously according to private companies' standards, thus being able to effectively control and manage all phases of the business and the final "product". Among other advantages, this leads to greater transparency and control of the company's financial management. The definition of responsibilities is probably the most important parameter for a successful operation when setting up an enterprise. The role of the new body and the relationship with all transport companies should be clear and examined in detail.

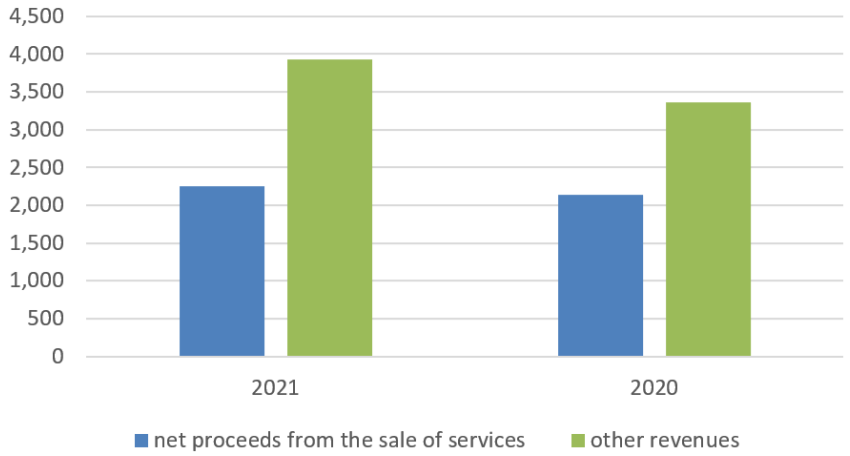

Figure 10. Revenue of the transport company (2020–2021).
Source: Company's accounting documents.

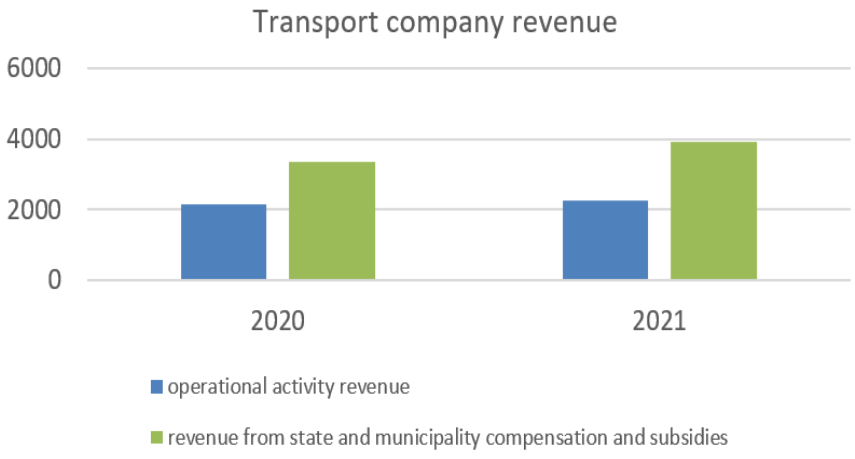

Figure 11. Transport company revenue (in EUR thousands).
Source: Company's accounting documents.

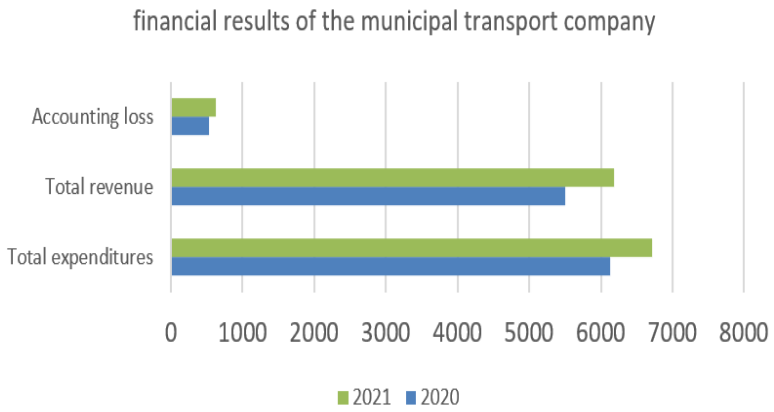

Figure 12. Financial results of the municipal transport company (in EUR thousands).
Source: Company's accounting documents.

The only reason for reducing the loss is the financial income received by the company each year. Thirdly, the company's financial resources, characterized by the financial autonomy indicators and indebtedness, show it could face difficulties in its solvency in the future. The equity ratio is low, and the debt ratio is also low. The main share is taken up by financing (**Figure 13**).

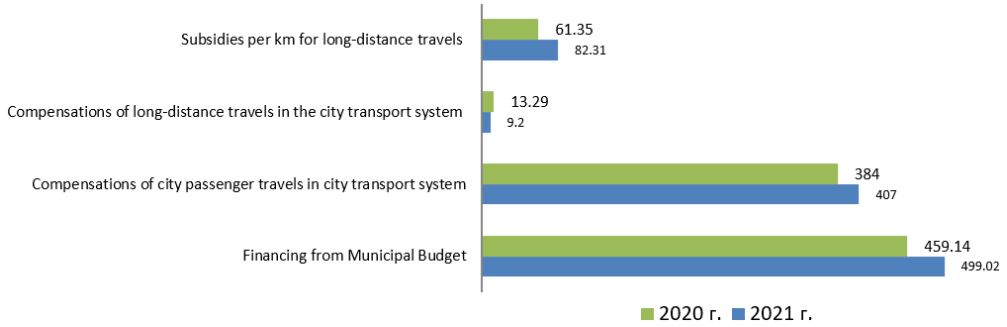

Figure 13. Finance from the budget of Stara Zagora municipality to transport company in EUR thousands.
Source: Company's accounting documents.

Fourthly, the indicators for total, quick, and immediate liquidity are favorable and do not, at first sight, indicate that the company has liquidity problems. All these take values that are above the minimum required by good management practices. The analysis of cash flows from operating activities shows that the company is unable to support operating activities on its own, as the type and nature of the service provided are linked to compensation and subsidies, and obligations arising from the applicable operating regulations.

The negative financial result from ordinary activities (operating loss) determines negative values of the ratios characterizing the efficiency of the operating activity. This also applies to cost efficiency and its reciprocal indicator revenue efficiency. The figure shows the calculations of these two indicators with and without financing income (**Figure 14**). Their values are unfavorable.

Figure 14. Total state budget funding for city transport services.
Source: Company's accounting documents.

Revenue efficiency is above unity in both calculated variants, which is evidence of the inefficiency of the operational activity. The efficiency of all revenues including revenues from services provided and funding is 1.09 for 2021 and 1.11 for 2020, respectively (**Figure 15**). Despite some improvement in the value of the indicator, it remains negative. To reach the tipping point (to move out of the loss area), expenditure should be reduced by a factor of 1.09 or revenue, including from the sale of services provided, and financing should be increased by the same factor. The results are even more negative when the financing received is deducted from the revenue. The revenue efficiencies in this variant of the calculation amount to 2.99 (for 2021) and 2.86 (for 2020). To get out of the loss zone without additional funding, the company needs to increase its revenues by a factor of 2.99 or reduce its expenses by the same factor. On the other hand, the cost efficiency is below unity when the indicator is calculated including all revenues. This confirms the conclusion that the operating activity is inefficient. Its values are respectively 0.92 for 2021 and 0.90 for 2020, confirming the negative finding on revenue efficiency already made. This coefficient is evidence that 0,17 euro of operating expenditure generates only 0.90 of revenue, including from funding received. When 63% of the total revenue received from financing is deducted from the total revenue, the cost-effectiveness deteriorates further: in this case, one lev (national currency) of expenditure generates only 0.17 euro of revenue.

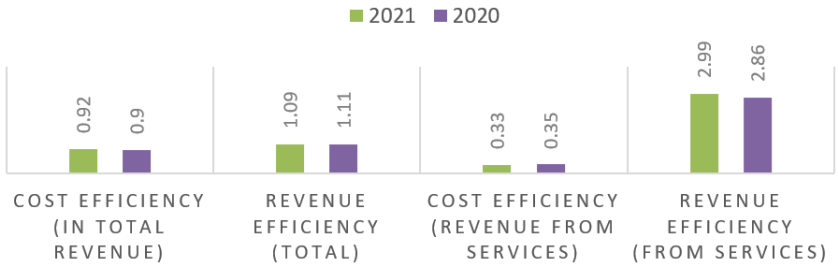

Figure 15. Revenue and cost efficiency ratios - two options: with and without funding revenue.
Source: Company's accounting documents.

Logically, the negative values of the revenue efficiency and cost efficiency ratios reflect the negative return on sales and equity. The accumulated loss on the company's balance sheet is evidence of this persistent negative trend. It is the result of the combined negative values of the return on assets and the return on revenue. The return on assets indicator stands at 0.26 for 2020 and deteriorates to 0.26 for 2021, respectively, and this is on the assumption that the indicator is calculated by taking total revenue without deducting the financing received (**Figure 16**). This indicator

shows that the assets owned by the company are not efficient.

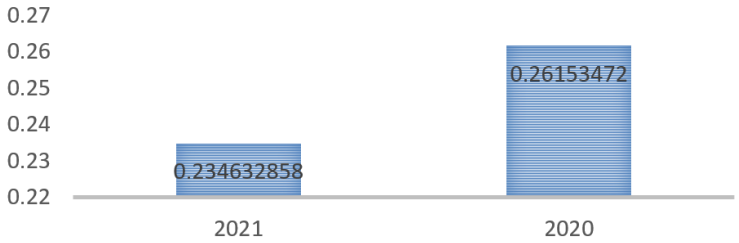

Figure 16. Return on assets calculated with total revenue including financing.
Source: Company's accounting documents.

Net return on revenue is calculated as the ratio of the financial result to the value of revenue. The figure for 2020 and 2021 is negative and amounts to −11% and −9% respectively (**Figure 17**). Despite some improvement, revenue profitability remains strongly negative. These negative values are the result of the already identified negative revenue and cost efficiencies. To achieve positive revenue profitability, it is necessary to improve operational efficiency that will put the transport company into the profit zone.

Figure 17. Profitability of total revenues and return on equity.
Source: Company's accounting documents.

The negative profitability of earnings is reflected in a negative return on equity. For the two years considered it is −20% (**Figure 17**). If the company fails to reverse the negative trend in its operating efficiency, it will continue to decapitalize, increasing the value of accumulated profits with each successive year. Due to the obvious constraints on earnings growth, reserves must be found in the company's cost model (**Figure 18**). If the financing received were deducted from earnings, the negative return on earnings and equity would in practice be multiple higher. Liquidity is important in determining trends in the company's financial balance. In practice, this means examining how quickly the company's assets in the form of current assets can be converted into cash to repay maturing debts to third parties. The total liquidity ratio, calculated as the ratio between current assets on the one hand and other short-term liabilities on the other, more than double in 2021, reaching a value of 3.60.

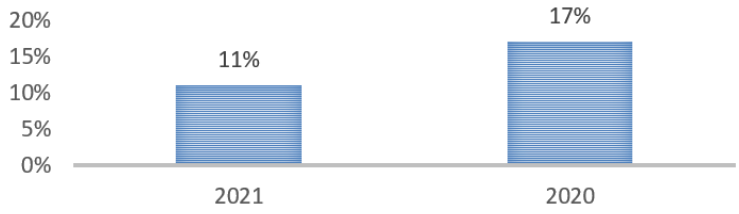

Figure 18. Financial autonomy ratio.

Source: Company's accounting documents.

Based on the analysis done, for which data from the official accounts of the company was used, it can be concluded that the company has satisfactory financial performance, which means that more reforms and changes are needed to achieve higher human capital efficiency in the company. It is important to note that public transport in the municipality of Stara Zagora generates its main revenue from the sale of single travel tickets, and the revenue to support the activity is derived from the remuneration of the contracting authority for the performance of the transport service and compensation and subsidies from the state budget. The increase in revenue achieved is largely due to the rise in ticket prices and at the same time is accompanied by a high rate of increase in costs. This is because the country is facing serious inflationary pressures and the wage updates are leading to the melting of profits and also unsatisfactory servicing of the company's buses. Thus, the out-of-service of several buses has an impact on the increased cost of repair services and external service costs associated with the operation of transport services. To an additional extent, the company's supplementary financing is mainly to replenish the wage bill, while no funds have been allocated to improve the physical environment and core business, further depreciating the company's infrastructure. If these problems worsen, it is possible that the efficiency of the core business will be affected and the company will be declared insolvent in the short term. Given the expected reforms and renewal of the bus fleet, such a negative trend would not be relevant within the 2024–2026 period. This is a period in which the company must overcome difficulties and move towards sustainable normal reproduction and setting aside its own depreciation capital. Another possibility to reduce the loss is revenue from EU programs and projects and increased funding through additional subsidies from the municipality or the state to support public transport in the country, given its social role. The assessment for the period 2020–2024 shows that there are periods in which the company has difficulties with its solvency. Another option is to privatize 35%–40% of the company, which would create an opportunity for local businesses to invest in public transport. The equity ratio is low, and the debt ratio is also low. The main share is taken up by financing. In most cases, the plans developed are adaptable for the moment or a short period but do not always produce results. In addition, the company's financial sources, as characterized by the company's financial autonomy and indebtedness indicators, show that the company is in need of a longer-term development and financial recovery program.

4.4. Opportunities for the development of the transport system of Stara Zagora municipality

In spatial terms, we should bear in mind that the city of Stara Zagora forms an integrated transport system, which is the result of the development of urbanization processes and socio-economic processes at the level of settlements in the municipality. Transport is carried out in several main ways, each of which uses specific vehicles, infrastructure, and organization, forming a local transport system within the city. Within the municipality of Stara Zagora, the transport system is a complex, dynamic socio-economic system aimed at citizens and economically active persons. It includes

all modes of transport, means of transport, roads, transport hubs, storage facilities, and repair enterprises within the municipality of Stara Zagora. The individual elements are interconnected, interact, have a common management, and serve the economic transports. Based on our analyses and forecasts we have proposed four alternative and complementary options for the development of urban transport. In the first variant of an alternative transport scheme for the municipality of Stara Zagora, we propose to actively use the three available bus stations. A key role should be played by the central bus station, which should be a link to the vehicles coming from the eastern bus station, where passengers and freight should be transferred to the western part of the city.

Stops are spaced 250–300 m apart. The proposed new routes make use of existing stops and build new stops in the newly developed parts of the city. Vehicle routes and passenger stops are correctly located. This indicates that the methodology for route design and stop location has been followed.

The two alternative scenarios proposed are based on the analysis of the available information, the transport system designed not to use the two bus stations built in the city, the spatial analysis of the urban development of the city, the possibility of ensuring the accessibility and connectivity of all the main anchor points of the city, and the sociological survey of residents using public transport. These transport schemes should be tested by the company at a later stage, gathering sufficient information on mileage, passenger flows and costs to allow comparison of the scenarios. This comparison will be the subject of further studies. Such a comparison will change the aims and objectives of this study.

In this scenario, all bus services coming from the villages would stop at the two termini in the east and west of the city. From there, passengers would be provided with one-stop transport access to the city center and their workplaces (**Figure 19**). The southern villages will be served by bus services that have a terminus at the Central Bus Station. In this option that we are proposing, we have a load on the two new bus stations that are actively coming into operation. In this way, we have a clear distinction between urban and inter-village services. In addition, savings are made in this way because excessively long inter-urban and urban runs are shortened, bus mileage is reduced, the number of buses is also reduced, and empty runs are reduced. Also, this will avoid duplication of urban lines and traffic congestion.

Figure 19. The first scenario of a transport scheme.

Source: Own sociological research.

In the second scenario, the authors propose to change the transport scheme by

starting to use the bus station in the western part of the city and the Central Bus Station (**Figure 20**). The eastern villages would be served by bus services with the optimized inter-village routes we propose. In the urban area, we propose minimal changes to existing routes, running to their current termini. The western villages will be grouped into lines that reach the bus station in the western urban area. Routes to the southern villages are also proposed to be optimized into basic vectors, with the end point of the lines being the Central Station of the municipality. The urban lines are maintained in their current form. The third group of lines is the proposal to introduce the four new urban lines. This option is the most optimal and will lead to the greatest optimization of the transport scheme of Stara Zagora municipality.

Figure 20. The second option of the transport scheme.
Source: Own sociological research.

The proposed new lines for the two scenarios were analyzed using the ArGis online spatial analysis platform (**Figure 21**). The analyses show a high potential population within a 300 m radius around the proposed bus routes, as shown in the attached diagrams. For spatial network analysis, the gravity model of the study is used. Based on the indicated population covered by the new lines, we can conclude that we have a high ridership assuming that the current urban transport load is 10%–15% of the municipality's population. This means that we have a potential passenger flow of around 1500–6000 per day for the different lines.

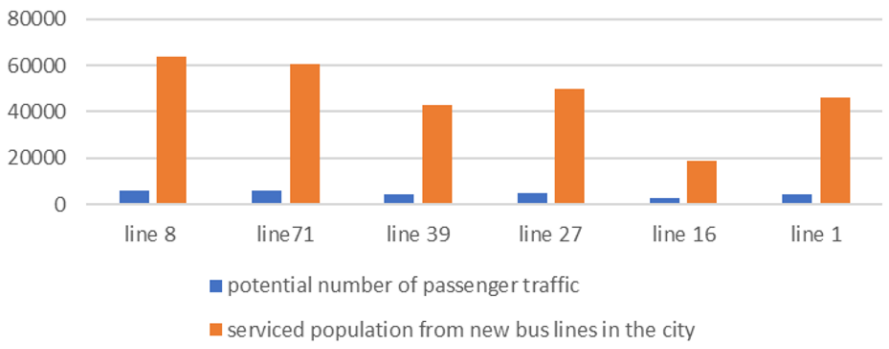

Figure 21. Population and potential passenger flow within a 300 m radius around the proposed new urban lines.
Source: Own sociological research.

In the framework of the analysis of the public transport stops of Stara Zagora, the congestion and isochrone (gravity) of the stops were measured about the potential

number of the population served within a radius of 300.00 m around each stop. For the needs of the field study, the specialized software platform ArGis was used for spatial analysis of the territory and transport in the municipality. The analysis using the methodology described in this way shows that the stops located within the city of Stara Zagora cover a large population within a radius of 300 m. around them or 5 min walking distance. As can be seen from the following diagrams, the majority of the stops have a significant demographic potential to serve the population. Therefore, the existing public transport lines in the municipality of Stara Zagora do hide not a small potential of potential passenger flow around the existing lines. Therefore, and in the analyses so far, we conclude that the serving trolleybus and bus lines in Stara Zagora are optimal together with the existing network of public transport stops.

The methodology for calculating the population served by bus stops in the city of Stara Zagora follows the sequence described:

Input data—transport zones with population (polygon layer), bus stops (point layer), and buildings with floor and footprint data (polygon layer).

1) Building polygons intersect with transport zones. A list of all buildings is obtained, with information on each one in which transport zone it falls. To obtain the RZP of each building, multiply its step by the number of floors.
2) A 300-meter buffer of stops is made.
3) The buffer of stops is intersected with the polygons of the buildings, which carry information about the transport zones and the RZP. A list is obtained in which each building falls within a buffer of 1 or more stops/lines.
4) The area of all buildings is collected both by stop (by line) and by transport zone (since a stop/line can overlap more than 1 transport zone).
5) Sum the floor area of all buildings by transport zone. A list of transport zones is obtained, in which the total sum of the building's floor area is calculated.
6) Then, a ratio is made between the floor area calculated relative to the stop buffer and the total floor area floor area for the transportation zone. We obtain a factor.
7) Use the factor by multiplying it by the total population for a given transportation zone. This gives the population served by 1 stop (1 line) for a given transport zone.
8) In the last phase, the population of the different transport zones for each stop is added.

The analysis using the methodology described in this way shows that the stops located within the city of Stara Zagora cover a large population within a radius of 300 m (**Figure 22**). around them or 5 min walking distance. As can be seen from the following diagrams, the majority of the stops have a significant demographic potential to serve the population. Therefore, the existing public transport lines in the municipality of Stara Zagora do hide not a small potential of potential passenger flow around the existing lines. Therefore, and in the analyses so far, we conclude that the serving trolleybus and bus lines in Stara Zagora are optimal together with the existing network of public transport stops.

Figure 22. Map of gravity fields at public transport stops in Stara Zagora.
Source: Own sociological research.

The assessment and analysis of the spatial development of Stara Zagora municipality and the transport services offered are directly dependent on the available infrastructure. This implies a combination of transport services according to the emerging urbanization needs, historical interest, and their touristic importance for the development of Stara Zagora municipality.

5. Conclusion

The importance of urban transport is characterized by its social and economic functions, providing conditions for sustainable urban mobility and influencing the regional economy. Urban mobility creates the conditions for the necessary connectivity between different parts of cities, including the link between urban and non-urban areas. In the examined case of Stara Zagora municipality, the need to improve the transport provision of citizens is visible, as well as the need to reduce the costs and subsidies of urban transport. The analyses show that Stara Zagora municipality has a good transport connectivity. Still, the upsurge of urban construction, the changing economic profile of parts of the urban space, and other reasons for urban transformation make it necessary to improve the transport system and build well-functioning and green transport. Public transport must be efficient and encompass the whole city, reaching all parts of the urban space.

The new public transport system is intended to raise the quality of service provided to citizens by public transport and increase its prestige. Therefore, improving the urban transport framework should rest on a sustainable model for assessing the spatial and transport development of Stara Zagora. On this basis, two models are being prepared (updated and optimized) for the transport scheme of the municipality of Stara Zagora. Based on the proposed research methodology, the authors reach some main conclusions. The authors consider the routes with duplication and overlapping in the main thoroughfares. These observations are evidenced by the spatial assessment, reference to expert judgment, and analysis of individual route alignments and public transport stops, which requires further exploration of the transport system. Concurrently, within the Stara Zagora municipality, it is imperative to contemplate the implementation of an urban zone with low emissions. This would entail an integrated approach appliance encompassing intelligent systems, information and communication tools, renewable energy sources, electric transport and local charging policies, sanctions, and control, as well as restrictions on the regime of vehicles in

certain time zones or days. To optimize the charging schemes of commercial establishments in the central part of the city, commonly referred to as the 'green zone', and to introduce a schedule to reduce the traffic load in peak hours. The introduction of loyalty schemes, such as subscription cards with business preferences for municipal means of transport, and investments in business models, such as bicycle and electric vehicle rental stations in front of business establishments, are also recommended. The introduction of e-ticketing and an Integrated Fare System is intended to facilitate passengers when transferring from one bus line to another without paying additional fares. The objective is to integrate other services for citizens into the electronic card, transforming it into a Citizen Card (e-wallet), enabling the rental of bicycles, the use of public transport, the payment of parking fees, and the payment of local taxes and fees. Negotiations with businesses and commercial establishments are underway to launch free lines for their customers and workers and to purchase public transport cards for employees at preferential prices. The novel approach offers a multitude of potential avenues for further optimization of transport routes, as well as the possibility of implementing additional policies for the transport system improvement in the suburban area and other locations within the municipality.

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