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Rail transport in the Warsaw agglomeration as a determinant of sustainable transport

Abstract: This article describes the conditions for the functioning of railway transport in the area of the Warsaw agglomeration, the legal conditions for the functioning of metropolitan areas and attempts to define the areas of development and limitations for sustainable transport. Due to the professional experience of the authors, an additional issue discussed in this study will be the functioning of rail transport on the example of the Fast Urban Railway sp. z o.o. in Warsaw.

Keywords: Agglomeration; Railway transport; Suburban train

Introduction

Urban transport is increasingly treated as one of the elements of urban logistics, which deals with the optimization of processes taking place in urban space. In particular, this applies to streams related to the movement of goods and people. The ever-increasing level of urbanization makes analyzing transport problems a permanent part of the work of specialists. In addition, the progressive suburbanization process means that the concept of urban transport is more and more often replaced by the concept of agglomeration transport. The emergence of organized forms of transport is closely related to the development of cities and economic areas.

Issues related to meeting transport needs, the impact of environmental awareness on the perception of urban transport, as well as the possibility of developing sustainable transport in metropolitan areas are the scope of interest of the authors.

This paper describes the conditions for the functioning of railway transport in the area of the Warsaw agglomeration, and the legal conditions for the functioning of metropolitan areas, and attempts to define the areas of development and limitations for sustainable transport. Due to the professional experience of the authors, an additional issue discussed in this study will be the functioning of rail transport on the example of the Fast Urban Railway sp. z o.o. in Warsaw.

This paper will attempt to define opportunities and threats for the development of agglomeration transport based on issues related to passenger railway carriers and railway infrastructure.

The study omitted a detailed analysis of the modernization and construction of railway infrastructure within the Warsaw railway junction and their effects on increasing transport capacity. In addition, a detailed analysis of the functioning of other railway carriers in the area of the Warsaw agglomeration was omitted.

Political conditions of the state towards the metropolis

Urban policy is an interdisciplinary area combining many sectoral fields. The actions of authorities at every level—central, regional, and local—have an impact on the development of cities. After analyzing the applicable legal regulations and the strategy in the field of transport, the authors did not identify the existence of a central and integrated urban policy. There is also no defined strategy for metropolitan areas. The lack of appropriate legislation results in a shortage of instruments supporting the process of metropolitan integration in Poland.

The document setting out the priorities for the country's development over the next 20 years is the study "Poland 2030. Development Challenges", which is the diagnostic basis for the currently developed strategies in Poland. The study indicates that despite the identified civilizational delays from the previous decades, in particular in terms of transport, the leaders of competitive changes have been identified, which are metropolises as centers that use intellectual capital, development dynamism, and readiness for change and adaptation. The report indicates that the most significant Polish metropolises that combine a high level of development and positive regional impact are: Warsaw, Krakow, Poznań, Wrocław, and the Tri-City. They are indicated as the necessary factors for the development:

- a. trust,
- b. consistency,
- c. creativity,
- d. mobility,
- e. competitiveness [1].

For the dynamic development of the country, the role of the central government is to eliminate barriers in the management process, with particular emphasis on legal barriers limiting effective integration in metropolitan areas.

The document setting priorities in the field of regional development is the "National Strategy for Regional Development 2030", which defines seven challenges for regional policy [2]:

1. Adaptation to climate change and reduction of environmental threats.
2. Counteracting the negative effects of demographic processes.
3. Development and support of human and social capital.
4. Increase in productivity and innovation of regional economies.
5. Development of infrastructure enhancing competitiveness, investment attractiveness and living conditions in the regions.
6. Increasing the effectiveness of development management (including financing development activities) and cooperation between local governments and between sectors.
7. Counteracting territorial inequalities and spatial concentration of development problems and mitigating crisis situations in degraded areas.

In addition, the document in question defines specific objectives determining the process of regional development, with particular emphasis on the objective of developing infrastructure supporting the provision of public services and increasing the investment attractiveness of areas. The justification for the above objective indicated that despite the effects of reducing development delays and eliminating the infrastructural gap, there is still a need to maintain intervention in the field of regional policy in this area. It was pointed out that it is necessary to continue activities for the development of infrastructure, in particular those aimed at building a network of transport connections and modernizing the infrastructure for environmental protection, energy, as well as telecommunications infrastructure ensuring access to digital services [2]. The above actions are aimed at equalizing the differences in access to public services between and within the regions. Activities under the regional policy

will include increasing the use of the railway potential, e.g. in the area between and within the agglomeration.

In 2019, the "Strategy for Sustainable Development of Transport until 2030" was published, the aim of which is to increase transport accessibility while improving the safety of traffic participants and the efficiency of the transport sector by creating a coherent, sustainable, innovative, and user-friendly transport system in the national, European, and global dimensions. The implementation of this objective will allow for the development of favorable conditions conducive to the stable economic development of the country, which is a function of accessibility [3]. The implementation of the main objective of the strategy is related to the implementation of six directions of intervention appropriate for each mode of transport:

1. building an integrated, interconnected transport network for a competitive economy;
2. improving the organization and management of the transport system;
3. changes in individual and collective mobility;
4. improving the safety of traffic participants and transported goods;
5. reducing the negative impact of transport on the environment;
6. improving the efficiency of using public funds for transport projects [3].

In the absence of a metropolitan act for all areas in the country, the Warsaw agglomeration is forced to function based on general legal regulations regarding local government, which do not take into account the specificity of highly urbanized areas. The current legislation on metropolitan planning and forms of cooperation between local government units is of key importance for agglomeration. The main objective of introducing appropriate regulations should be to create the basis for achieving socioeconomic cohesion.

Warsaw agglomeration

An urban agglomeration (Latin: agglomeratio, accumulation) is a morphological unit that creates a harmonious set of mutually related settlement units as a result of the concentration of buildings and development [4]. Agglomerations are characterized by a significant flow of people and goods, as well as a significant exchange of services. In a more colloquial understanding, an agglomeration is a cluster of neighboring towns and villages that form a common organism by integrating or complementing various forms of infrastructure in given towns and making mutual use of the potential that these towns have at their disposal. Types of agglomerations due to the character of the center:

- a. monocentric - having one most important city,
- b. polycentric - having several important urban centers - also called a conurbation.

A monocentric agglomeration is a large population center with an urban center (the so-called core), surrounded by satellite towns and urbanized villages. Satellite cities most often function as sleeping or industrial districts. Over time, the suburban area may be absorbed by the expanding city, becoming an integral part [5].

The concept of agglomeration in the context of the Warsaw agglomeration means the process of concentration around the city and the concentration of the population and economic entities around this city. The very process of the above concentration is reflected in changes in the forms of land use and the intensity of land development. The agglomeration is a spatial and functional whole. In the example of the Warsaw agglomeration, it can be stated that the term agglomeration itself defines a concentration of settlement units linked by strong relations regarding the flow of people, goods, money, and information. Of these units, at least one is of sufficient size and centrality and generates sufficiently strong links [6].

The Warsaw agglomeration is a typical monocentric agglomeration; its character is determined primarily by the size and functions of the country's capital. Warsaw is a

multifunctional urban center dominated by administrative, scientific, cultural, commercial, and communication functions. As the capital of Poland, Warsaw is the seat of the highest state authorities as well as numerous central institutions, i.e., the headquarters of commercial banks, diplomatic representation, and science management units such as the Polish Academy of Sciences. The largest airport in the country is located in Warsaw. In addition, due to its history, Warsaw is a place often visited by tourists, both domestic and foreign.

When considering the key problems of the functioning of the Warsaw agglomeration, one should note the complexity of the spatial and structural system, the multitude of factors affecting development (resulting from external calculations or independent investments), and the existing state of spatial development.

The Warsaw agglomeration is constantly looking for effective solutions regarding the organization of a public passenger transport network serving the entire agglomeration. An organizer of urban transport was appointed—the Public Transport Authority, which represents the capital city of Warsaw in negotiations regarding the functioning of joint communication. The Public Transport Authority introduced a uniform transport tariff and transport regulations and constantly conducts public consultations related to the expansion of the transport network. Warsaw is one of the few cities with a very well-developed rail transport network. The greatest demand for transport services is recorded in the morning rush hours toward the city center and the afternoon rush hours away from the city center. In addition to tram connections, the city has developed a metro and railway network. Despite this, rail transport, in the opinion of some, has a lower quality and is at the same time less competitive than an individual means of transport, which is a car. The forecasts for the next years include increasing the attractiveness and efficiency of urban transport while limiting the role of the passenger car.

The implementation of the sustainable development policy is the adoption and implementation of the transport system development strategy, which may be the basis for the development of the capital city of Warsaw. The capital city of Warsaw has developed a "Strategy for Sustainable Development of Warsaw's Transport System," providing a sustainable plan for the development of Warsaw's public transport.

In order to define the strategic assumptions and operational plans in the field of sustainable urban transport in the area of the Warsaw agglomeration, documents were established:

- a. Strategy for Sustainable Development of the Transport System of Warsaw until 2015 and for the following years, including the Sustainable Development Plan for Public Transport in Warsaw;
- b. #Warsaw2030 strategy;
- c. Warsaw for Climate;
- d. Communication without barriers.

The document "#Warszawa2030 Strategy" defines strategic and operational goals, including goal 3.3. "We use a friendly transport system." The implementation of the objective requires the use by the Office of the Capital City of Warsaw system solutions including:

- a. cooperation with the communes of the Warsaw metropolitan area,
- b. integration of activities in the field of digitization of the city,
- c. subordinating the management of municipal real estate to the spatial policy of the city [7].

The implementation of the above objective will determine the implementation of other objectives set out in the strategy, including in particular those related to the improvement of the quality of the natural environment.

There are several transport subsystems in operation in Warsaw, so the main goal of the sustainable development policy is the integration of transport systems that are beneficial both

for travelers and transport organizers. In addition to a common ticket for all means of transport or the development of the "Park and Ride" system, this integration will also include: the construction and modernization of transfer nodes, dynamic passenger information, and launching telematics systems for public transport [8].

The transport organizer strives to simplify and rationalize the layout of tram and bus lines and to eliminate mutual competition on the same transport corridors. Unfortunately, limiting the number of bus and tram lines may contribute to a reduction in direct connections, which in turn may contribute to a greater number of transfers, perceived as inconvenient for passengers [8].

At the same time, in the recommendations of the Warsaw Public Transport Council [9] published in 2019, the need to integrate travel management in the metropolitan area of Warsaw and the promotion of multimodality were identified, with the key area being, among others, public transport with stop infrastructure and transfer nodes. An additional aspect is the emphasis on multimodality as one of the key elements in the planning and implementation of mobility services. In addition, the study in question indicates a recommendation regarding the development of standards for the organization and operation of public transport services within the Warsaw metropolitan area, taking into account such aspects as: infrastructure design and construction, rules for the flow of information to users, equipment and marking of urban transport vehicles, transport safety and rules operation of the infrastructure. The Warsaw Public Transport Council determined the need to carry out research related to the expectations and assessment of the functioning of public transport, as well as an analysis of future transport needs, to determine the target operation of the Public Transport Authority in the area of the Warsaw agglomeration. From the analysis of the recommendations published in 2019, we can conclude that the Warsaw transport organizer recognized the challenges related to the integration of transport and its accessibility, problems regarding the planning and implementation of transport to meet the transport needs of the agglomeration, as well as the need to strengthen the flow of information to users of means of transport, including in particular the digitization of mobility services.

Urbanization

Urbanization is defined differently by different scientific disciplines. The origin of the term "urbanization" is related to the emergence of the city, the development of urban life, and the increase in the economic role of the city as opposed to rural areas. It is a process of social and cultural transformations in spatial development, leading to the deepening and assimilation of life patterns and behaviors by the urban population [10]. Urbanization covers the entirety of human activity and life and is a multifaceted concept [10]:

- a. demographic,
- b. economic,
- c. social,
- d. spatial.

There are three key phases in the urbanization process:

- a. urbanization,
- b. suburbanization,
- c. deurbanization.

For the purposes of this study, the authors will analyze the issue of suburbanization and deurbanization.

Suburbanization is the urbanization of the suburban area. It includes not only the outflow of the population but also institutions (including business entities) from the city center to the periphery. This concept is related to the process of metropolisation—the weakening or breaking of economic links between the center and the periphery of the city.

This phenomenon in the literature is called the process of relative decentralization [11]. They are caused by a decrease in the population density in the center and an increase in the outskirts of the city. We distinguish the following causes of suburbanization:

- a. reversing the migration trend (from the village-city to city-village) in search of a cheaper life with a more attractive landscape, while ensuring jobs and easy access to services,
- b. striving to have one's own home, which may evoke a sense of social advancement,
- c. increase in prices of housing and living in cities,
- d. low cost of housing in the periphery as opposed to the cost of living in the center,
- e. lower costs of living on the outskirts of the city,
- f. land speculation, uncontrolled land turnover escaping from planning regulations in the process of transforming agricultural plots into non-agricultural plots,
- g. development of construction of single-family houses and tourist facilities,
- h. the progressing process of improving the living conditions in the countryside related to the availability of infrastructure and the development of individual motorization, facilitating access to services and workplaces [12].

The next phase of urbanization is deurbanization. It is not so much a consequence of suburbanization as its degeneration. It is a socio-cultural process characterized by the outflow of people from large urban centers to areas stretching between them. The urban population begins to shrink in numbers in favor of the non-urban population. In addition, with the outflow of population, the city center loses its economic importance in favor of previously poorly developed or non-urbanized areas. There is a decrease in the proportion of urban to rural populations [13]. On a global scale, there is a negligible probability of deurbanization. There is a good chance that agglomeration areas will grow and merge. Then metropolitan regions will be created that will contrast with other areas - in terms of growth dynamics and population.

An interesting form of de-urbanization is urban sprawl, i.e., the spreading and dispersal of buildings, which takes place in many European countries. It is an uncontrolled process in large cities and the opposite of a compact city. The effects of urban sprawl have character [14]:

- economic - development of infrastructure, increase in transport costs, development of individual transport, reduction in the number of investments in the city center,
- ecological - occupation of agricultural and/or forest areas, increase in the emission of harmful substances from exhaust fumes, loss of open spaces,
- social - disappearance of social ties, social segregation,
- aesthetic - monotony of buildings, the devastation of the landscape.

Rail transport in the Warsaw agglomeration

Within rail passenger transport, four subsystems can be identified: interregional, regional, inter-agglomeration, and agglomeration transport. Regional and agglomeration transport is used to service agglomeration areas as well as metropolises. However, in the opinion of the authors, agglomeration railways have a much greater development potential due to their concentration on urbanized areas, as well as the provision of fast and quality connections between suburbs, satellite cities, and agglomeration centers. Agglomeration transport ensures the handling and movement of large flows of travelers efficiently and safely. Demand for agglomeration transport provided by rail means of transport has been increasing for several years, despite reservations related to, for example, the frequency or adequate supply of places in railway vehicles, which is why the appropriate establishment and implementation of public

transport policy can make them a tool to improve the competitiveness of collective transport in metropolitan areas.

In the segment of agglomeration transport, an increase in the importance of rail transport is forecast due to the relatively attractive commercial speed, high rail transport capacity, as well as congestion and other problems in the area of road traffic. The activities of railway undertakings participating in the implementation of the passenger transport process should focus on the purchase of new, interoperable rolling stock and the modernization of existing railway vehicles to improve the quality of service and integration with urban transport. Due to the increasing importance of passenger rail transport and its recognition as a development, infrastructural investments in metropolitan areas are necessary. The above-mentioned investments may include the construction of new railway lines, tracks, and facilities on railway lines in operation, as well as the revitalization of hitherto unused sections.

The "National Strategy for Regional Development until 2030" indicates that the railway infrastructure has been and is the subject of intensive modernization. The condition of the national railway infrastructure, despite numerous investments carried out in recent years, still requires further improvement. Deficiencies in the infrastructure, as well as insufficient capacity, insufficient parameters of the rolling stock (speed, power, dynamics), and improper organization of traffic resulted in unreasonable extensions of train routes, which in turn resulted in a decrease in the competitiveness of railways, and often a complete lack of possibility to offer an attractive transport offer [15].

Already in 2019, the National Infrastructure Manager published the presentation "Directions for the Development of the Railway Network in the Warsaw Railway Junction—Master Plan for Rail Transport in the Warsaw Agglomeration", which identified, among others, the potential for increasing traffic in rail transport in the agglomeration, the need to adapt the railway infrastructure to the actual transport needs, the inability to obtain a cyclical train timetable, and the lack of capacity for new trains [16]. The above restrictions prevent rail operators from creating a transportation offer that is attractive to passengers. The document published in 2019 "Directions of Development of the Railway Network in the Warsaw Railway Junction. Master Plan for Rail Transport in the Warsaw Agglomeration" defined the agglomeration traffic goal defined as the creation of a modern, comfortable and attractive means of public transport, integrated with the regional traffic that will be reached through:

- a. ensuring a cyclical and symmetrical timetable in hours,
- b. ensuring high frequency of trains running on railway lines, including cross-city lines and inlet lines (depending on the line, from 2.5 to 10 minutes during peak hours),
- c. creating a system of communication lines that is legible for travelers,
- d. where necessary - separation of agglomeration traffic from long-distance traffic that interferes with the operation of agglomeration trains,
- e. increasing accessibility by building new stops or adapting the existing ones to the planned or current development, as well as by building transfer nodes,
- f. multimodality and digitization of mobility,
- g. integration of the agglomeration connection system with the Central Communication Port,
- h. adjusting the technical solutions of traffic zoning stations to their functions [17].

Taking into account the above considerations, it can be concluded that:

- a. the transport offer within the agglomeration requires the use of fixed train paths in conjunction with regular train departures at regular intervals;
- b. there is an identified need to carry out investments resulting in the separation of agglomeration traffic from long-distance traffic;

- c. the use of new rolling stock by railway carriers significantly affects the comfort of travel and the perception of the quality of services;
- d. railway vehicles used for agglomeration transport should be characterized by a single-space interior layout, high capacity, an increased number of doors to efficiently accommodate passengers, designated places for larger luggage and bicycles, and should also be adapted to serve people with reduced mobility and the disabled ;
- e. the agglomeration railway is designed to counteract the excessive growth of car traffic, which is significantly limited due to delays related to the modernization of infrastructure.

Tab. 1. SWOT analysis (S - strengths, W - weaknesses, O - opportunities, T - threats) for agglomeration railways in Poland

Strengths	Weaknesses
<ul style="list-style-type: none"> – High trading speed. – Short travel time to the center of the agglomeration. – Large supply of transport places. – Rarely occurring congestion. – High level of safety (low risk of accidents). – Eco-friendliness. – Low unit energy consumption. – Low unit costs for a passenger with large passenger flows. – Low travel costs for the passenger thanks to subsidies from public funds. 	<ul style="list-style-type: none"> – The limited capacity of infrastructure in agglomerations (no division into long-distance and agglomeration traffic); – Location of stops not adjusted to current needs resulting from spatial development, partial transport exclusion. – Poor technical condition of the railway infrastructure; significant limitations in capacity and speed in agglomerations. – High costs of purchasing new rolling stock adapted to the needs of people with limited mobility. – Poor technical condition of the rolling stock. – Low quality of the transport offered and a bad image of rail transport. – Low level of personal security among travelers – Limited possibility of door-to-door transport – Lack of technical, organizational, tariff, and ticketing integration with urban and individual transport systems – Poor communication between various branches of urban transport
Opportunities	Threats
<ul style="list-style-type: none"> – EU policy promotes the sustainable development of transport. – Financial resources from EU funds for the development of ecological metropolitan transport – Modernization and purchase of new 	<ul style="list-style-type: none"> – Lack of sufficient funds and stability of financing for infrastructural investments and the purchase of rolling stock – Deterioration of the technical condition of linear and nodal

<p>rolling stock.</p> <ul style="list-style-type: none"> - Congestion and transportation bottlenecks, which reduce the competitiveness of other means of transport. - Taking action to integrate rail transport with the urban and individual transport system (Park&Ride, Bike & Ride, Kiss & Ride). - Implementation of integrated passenger information systems, taking into account various means of transport. - Tendency to include rail transport in the service of airports. - Financing by local governments of rail transport translates into shaping the transport offer. - Marketing activities for rail travel. 	<p>infrastructure</p> <ul style="list-style-type: none"> - Insufficient demand; lower than forecasted. - Investments in improving the condition of road infrastructure in agglomerations - Strong attachment of part of the community to individual transportation. - Low accessibility compared to regional bus transport.
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Rapid urban railway in Warsaw

Fast Urban Railway Sp. z o. o. in Warsaw is a railway company that provides transport and agglomeration services for the needs of the Capital City of Warsaw. Warsaw and its surroundings The Fast Urban Railway in Warsaw (SKM) is a municipal company operating on behalf of the Public Transport Authority (ZTM), which operates the overground city rail lines and complements the lines of the Warsaw Metro, which connect the center of Warsaw with selected suburbs and outskirts.

SKM conducts business activity in the field of rail transport services within the meaning of the Act of March 28, 2003, and has a valid license no. WPO/109/2005, authorizing it to perform rail passenger transport. Currently, it serves three routes (lines S1, S2, and S3). The SKM and the metro from the public transport network in Warsaw, supplemented by the trains of Koleje Mazowieckie, the Warsaw Commuter Railway, as well as bus lines. The uniform ticketing system for other means of transport in the capital is managed by ZTM. Pursuant to the Agreement on the provision of transport services using collective transport (in this case SKM trains) concluded between the Capital City of Warsaw and SKM passenger transport takes place on three agglomeration lines limited by Pruszków, Sulejówek Miłosna, Otwock, Legionowo, Radzymin stations.

Fast Urban Railway Sp. z o. o., with the participation of the Public Transport Authority, plans to expand its activities with further railway sections in the future. It is planned to create a network of connections to, among others: Piaseczno, Błonia, and Zegrze. Assessing the current rail routes served by the SKM, we can conclude that travelers can reach many districts and towns from the city center. A regular train runs, and increased rolling stock service during rush hours guarantee passengers, both regular and casual, a journey at a specific time with convenient transfers. The distinguishing features of SKM are:

- a. high frequency and cyclicity of service - runs over 240 connections daily;
- b. a large number of stops - e.g. on the S1 route with a travel time of 70 minutes, there are 24 stops;
- c. morning and afternoon peaks of passengers - the key supply of seats during commuting hours to/from work and school;

- d. connection with other means of public transport enabling convenient transfers;
- e. one ticket within the agglomeration;
- f. rolling stock enabling quick passenger exchange.

SKM trains carry over 22 million passengers a year and are an important element of Warsaw's public transport. SKM has at its disposal modern rolling stock type 14WE, 19WE, 27WE, 35WE, 31WEba and 45WEa.

Tab. 2. SKM rolling stock

Vehicle type	Manufacturer	Liczba pojazdów	Document No. admitting the railway vehicle (Certificate/Permission)	From the day	Valid document
14WE	NEWAG S.A.	2	T/2007/0136	23.07.2007	permanent
19WE	NEWAG S.A.	4	T/2011/0694	31.08.2011	permanent
27WE	Rail Vehicles PESA Bydgoszcz S.A. Holding	13	PL8020210183 PL8120212183 (ezy 001-003) PL8120212184 (ezy 004-006) PL8120212103 (ezy 007-009) PL8120212105 (ezy 010-013) PL8120211715 (ezy 011)	27.10.2021 22.12.2021 22.12.2021 15.12.2021 15.12.2021 27.10.2021	permanent
35WE	NEWAG S.A.	9	PL 59 2016 0039	26.08.2016.	permanent
31WEba	NEWAG S.A.	6	PL80202110224 PL8120212029 (ezy 001) PL8120212158 (ezy 002-006)	08.12.2021 17.12.2021	permanent
45WEa	NEWAG S.A.	10*	PL8020220151 PL8120221220 (ezy 001-015)	01.07.2021	permanent

* railway vehicles in the course of delivery, target number - 15 units

All railway vehicles at SKM's disposal are single-spaced, low-floor electric multiple units with technical solutions enabling fast and safe travel without sacrificing quality. Railway vehicles are adapted to serve people with reduced mobility and people with disabilities. The vehicles are equipped with a dynamic passenger information system and monitoring. 66% of the rolling stock is equipped with GSM-R digital radio communication and 36% with the European train control system ETCS. The above expenditures on modern solutions in the field of technical specifications for interoperability contribute to raising the standards of quality and safety of railway traffic.

The SKM train offers an attractive travel time to the city center, which is cheaper than traveling by car. Urban rail travel is also becoming fashionable, especially in environments

that promote an eco-lifestyle. The railway is much more environmentally friendly, not only looking at CO2 emissions but also at energy consumption, which can be reduced by using eco-driving. In Warsaw's SKM train drivers receive special bonuses for an ecological driving style.

Thanks to investments in the rolling stock, the SKM is becoming an increasingly comfortable way to travel. Thanks to the new rolling stock, passengers of the Warsaw SKM already have more seats at their disposal during peak hours, as well as comfortable places for a pram, large luggage, or a bicycle. The trains are equipped with USB chargers, electrical sockets, ticket machines, a modern passenger information system, and an AED defibrillator.

Summary

As a result of the analysis, it is impossible to clearly define a good and universal solution to improve the functioning of the transport system in metropolitan areas; however, there is no doubt that the main task is to change the proportion of participation in meeting the transport needs of residents with individual means to increase the share of public transport. The formation and development of metropolitan areas around the largest cities require entities responsible for the transport development policy to take up the challenge and responsible organization of communication services for the population. The development of the potential of rail transport as an element of sustainable transport in the agglomeration is not only conditioned by investments in the modernization of railway infrastructure and railway vehicles, but as well as the construction of new multimodal railway stops that would be adapted to the growing transport needs and intensive spatial development.

Taking into account the above considerations, the following conclusions can be drawn:

1. The main challenge for agglomerations is the lack of existing legal regulations defining their status and functioning, which implies the lack of a designated entity controlling the development and spatial development of the agglomeration as a whole.
2. Regional development strategies developed at the central level and the implementation of the set goals force local governments to further develop planning and coordination competencies, as well as mechanisms for financing infrastructural investments.
3. There is a mutual correlation between the two phenomena - a developing city generates transport needs, while the development of the city is supported by an organized public transport network.
4. Spontaneous and uncontrolled spatial development - urban sprawl - leads to irrational spatial management due to the lack of a supervisory entity.
5. The success factor of agglomeration transport is its integration with public transport in urban centers in technical, organizational, and commercial terms.
6. Increasing the competitiveness of public transport in terms of meeting the transport needs of the population is possible with the use of a high-quality offer together with additional services.
7. The development of multimodal transport in agglomerations is a determinant of meeting transport needs, developing regional areas, and improving the quality of the environment.

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