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## ANALIZA FUNKCJONOWANIA PUBLICZNEGO TRANSPORTU ZBIOROWEGO NA TERENIE SOSNOWCA

**Streszczenie:** Zgodnie z celami zrównoważonego rozwoju i zrównoważonej mobilności transport publiczny powinien być priorytetowym środkiem transportu na obszarach miejskich. Celem artykułu jest analiza funkcjonowania publicznego transportu zbiorowego na terenie Sosnowca. Zaprezentowano lokalizacje stacjonarnych punktów sprzedaży biletów na terenie Sosnowca, a także dokonano analizy zależności między liczbą odjazdów z przystanku autobusowego a wartością sprzedanych biletów w automatach biletowych.

**Słowa kluczowe:** publiczny transport zbiorowy, sprzedaż biletów, oferta przewozowa

## ANALYSIS OF THE FUNCTIONING OF PUBLIC TRANSPORT IN SOSNOWIEC

**Summary:** In line with the goals of sustainable development and sustainable mobility, public transport should be a priority means of transport in urban areas. The purpose of the article is to analyze the functioning of public collective transport in Sosnowiec. The locations of stationary ticket sales points in Sosnowiec were presented, and the relationship between the number of departures from the bus stop and the value of tickets sold in ticket machines was analyzed.

**Keywords:** public transport, ticket sale, transport offer

### 1. Introduction

The dynamic development of Polish cities and the related changes in lifestyle contribute to the increase in transport needs [1]. In line with the goals of sustainable development and sustainable mobility, public transport should be a priority mode of transport in urban areas [2-8]. Human functioning is related to the need to move, which determines the possibility of satisfying human needs. Public urban transport

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enables the simultaneous movement of more people with the same means of transport, and thus relieves the city's transport system [9].

In densely built-up and populated areas, people travel by public transport. The continuous development of public transport is directly related to the increase in the population and area of cities and the development of technology [10].

Górnośląsko-Zagłębiowska Metropolia is a metropolitan union located in the Silesian Voivodeship. It was established on the basis of the Act on the Metropolitan Union of March 9, 2017 and associates 41 communes of the Silesian Voivodeship. This metropolis is focused on spatial, social and economic integrity and cohesion in order to ensure an adequate level of quality of life for its inhabitants. [11]. The metropolitan union carries out public tasks in the field of:

- shaping the spatial order,
- social and economic development of the metropolitan union area,
- planning, coordination, integration and development of collective public transport, including road, rail and other rail transport, as well as sustainable urban mobility,
- metropolitan passenger transport,
- cooperation in determining the route of national and provincial roads in the area of the metropolitan association,
- promotion of the metropolitan union and its area.

Sosnowiec is a city with powiat rights located in the Śląskie Province (the central area of the Province). Additionally, Sosnowiec is a member of the Metropolis GZM. The area of this city is 91.06 km<sup>2</sup>, and the number of inhabitants is approximately 198,000 (as of December 31, 2020). The population density in the city is 2,170 people/km<sup>2</sup>, which indicates the need to provide public collective transport at a high level [18].

The purpose of the article is to analyze the functioning of public collective transport in Sosnowiec. The locations of stationary ticket sales points in Sosnowiec were presented, and the relationship between the number of departures from the bus stop and the value of tickets sold in ticket machines was analyzed.

## **2. Public transport in Sosnowiec**

Organizing public collective transport is one of the most important tasks of the commune, ensuring unity and coherence of activities in the commune [12-14]. In the Metropolis GZM, the Metropolitan Transport Authority is responsible for the organization of public transport, which was established by the merger of three public transport organizers (the KZK GOP, the MZK Tychy and the MZKP Tarnowskie Góry) and has been functioning since 2019.

The result of establishing the ZTM was tariff integration, i.e. the process of integrating various public transport organizers. The aim of this action was to make it easier for passengers to use public transport in the GZM area and to increase the share of public transport in the total trip.

There are bus and tram communication in the area of Sosnowiec. Figure 1 shows the number of communication lines broken down into bus and tram transport.

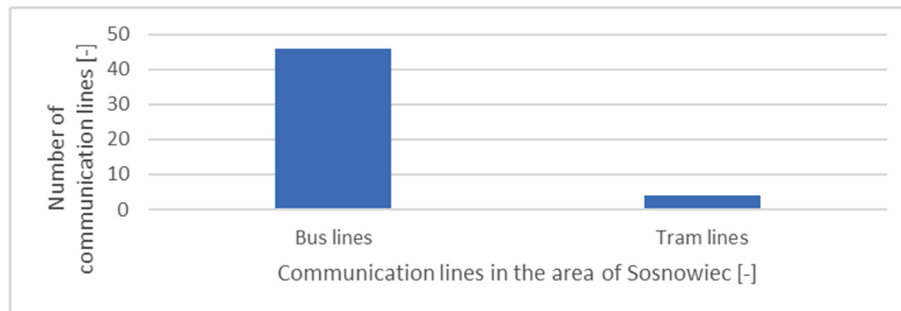


Figure 1. Communication lines in Sosnowiec

It can be noticed that in the area of Sosnowiec, bus communication predominates (bus lines account for 92% of all communication lines. This may be due to insufficiently developed tram infrastructure or higher costs of tram transport compared to bus transport.

Figure 2 shows communication lines operating in Sosnowiec in terms of public collective transport operators providing transport services.

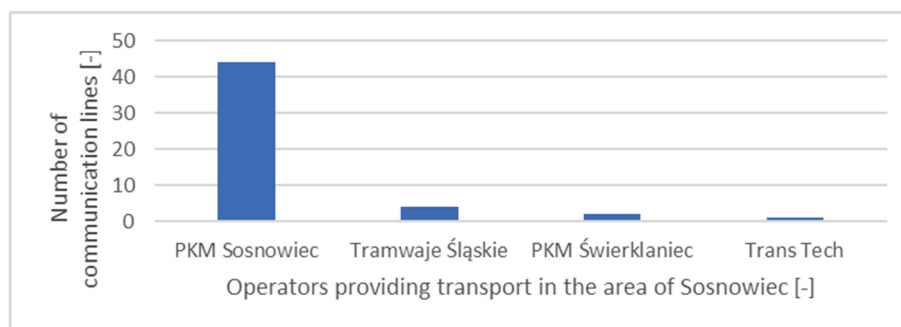


Figure 2. Operators providing transport in the area of Sosnowiec

In the area of Sosnowiec, most lines are served by the operator PKM Sosnowiec LLC. This may be due to the fact that the majority of shares in the company belongs to the City of Sosnowiec. The fewest communication lines are served by the Trans Tech operator. In the area of Sosnowiec, this operator serves only one bus line (line no. 154).

The next figure shows the division of bus lines operating in the area of Sosnowiec in terms of the line nature. Normal lines usually operate between 5-23 and serve all stops on their routes. Fast lines serve selected stops along the route. Metropolitan lines are 24/7 express connections financed by the Metropolis GZM.

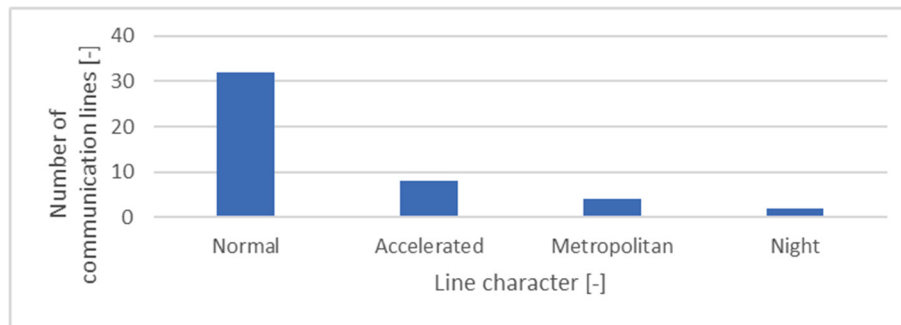


Figure 3. Division of bus lines operating in Sosnowiec due to the character of the line

When analyzing the figure presented above, it can be observed that in Sosnowiec there are the most normal lines and the least night lines. There are currently 4 metropolitan bus lines operating in the area of Sosnowiec. However, not all metropolitan lines have already been launched, so this number is not final.

### 3. Ticket distribution channels in Sosnowiec

In the Metropolis GZM, passengers can purchase paper and electronic tickets.

Passengers can purchase tickets for a trip in the following way:

- in one of sale points,
- in one of passenger service points,
- in one of solar ticket vending machines,
- through one of available applications,
- in one of ŚKUP ticket vending machines,
- in buses, trams and trolleybuses,
- through client portal in the Internet [19].

The figure below shows the number of stationary ticket sales points in the Sosnowiec area. Passenger service points, points of sale and stationary ticket machines were taken into account.

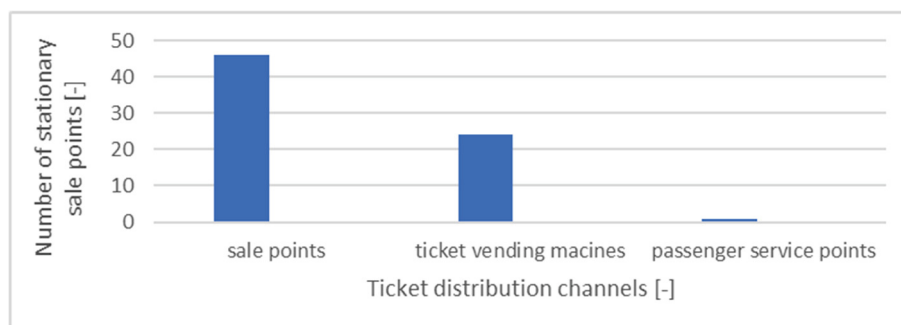


Figure 4. Ticket distribution channels in Sosnowiec

It can be noticed that in the area of Sosnowiec, taking into account ticket sales points, ticket machines and passenger service points, there are the most operating points of sale (44). There is only one passenger service point in the Sosnowiec area. It is worth noting, however, that in the entire GZM Metropolis there are only 10 such points. They are located in the largest cities belonging to GZM. There are 72 stationary ticket sales points in Sosnowiec, which gives an average of 0.78 ticket machines/km<sup>2</sup>.

The map below shows all stationary ticket sales points in the Sosnowiec area. Additionally, accessibility protections are marked. Walking accessibility helps you determine the easiest way to get to a certain location. The article assumes the value most frequently appearing in the literature that passengers are able to reach the stop, ie 400 m [15-18].

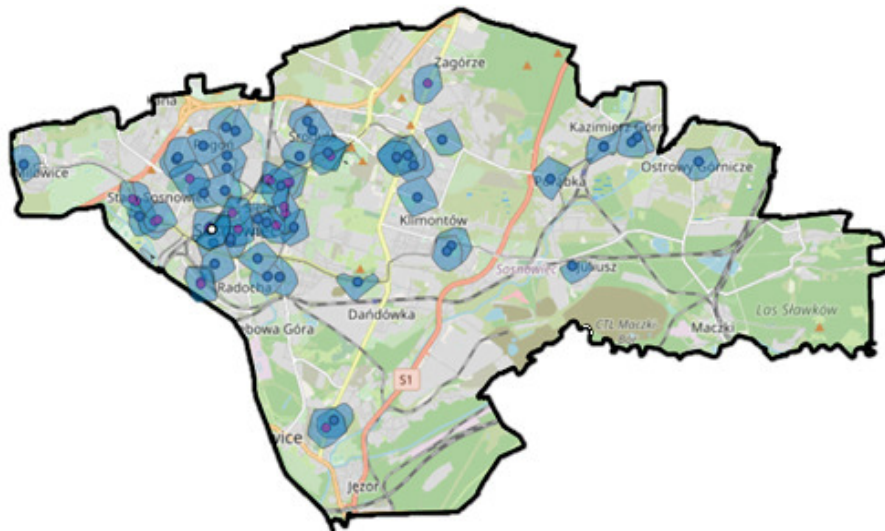


Figure 5. Stationary ticket sales points in Sosnowiec

It can be noticed that the most stationary ticket sales points are located in the central area of the city.

#### 4. Sale of tickets at ticket machines

As part of the work on the article, selected factors were also analyzed on the value of tickets sold in ticket machines in 2021 in the area of Sosnowiec. Regression models have been determined. Linear, power, logarithmic and exponential functions were analyzed. The model with the highest values of the coefficient of determination was selected.

The first factor taken into account was the number of lines serving the selected bus stops (those with ticket machines). The figure below shows the model

of the relationship between the value of tickets sold and the number of communication lines serving selected bus stops located in Sosnowiec.

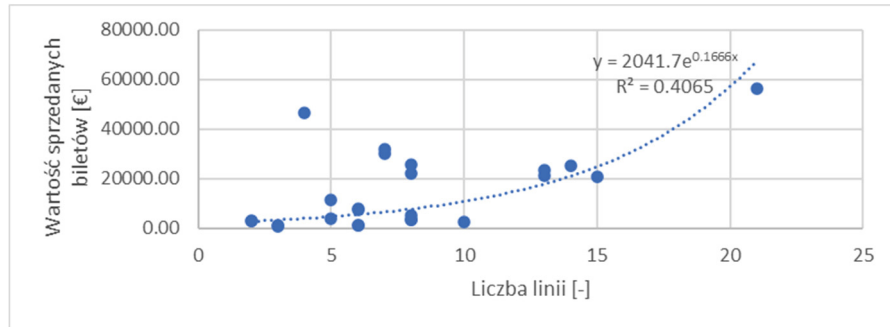


Figure 6. Model of dependence between the value of tickets sold and the number of lines serving selected stops

When analyzing the relationship between the value of tickets sold and the number of lines serving selected bus stops, the authors chose a logarithmic function. The value of the determination coefficient is 0.4065, which indicates a small relationship between the selected features. In the case of the other forms of the function (linear, power and exponential), the value of the coefficient of determination was lower than 0.4.

The second factor taken into account was the number of trips from the selected communication stops. Figure 7 below shows the model of the relationship between the value of tickets sold and the number of journeys of communication lines serving selected bus stops located in Sosnowiec.

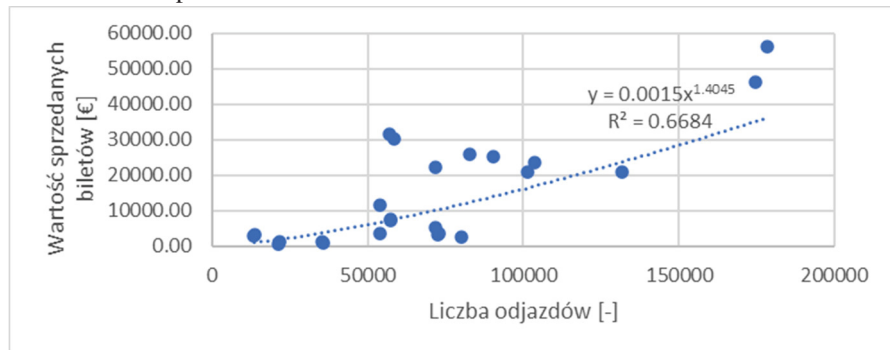


Figure 7. Model of the relationship between the value of tickets sold and the number of departures of communication lines serving selected stops

In this case, the power function was selected and the coefficient of determination is 0.6684, so it can be concluded that there is a greater relationship between the number of trips of communication lines serving selected stops than between the number of lines. This may be due to the fact that communication lines run at different frequencies, which affects the number of trips from the indicated communication stops.

## 5. Summary

The aim of the article was to analyze the functioning of public collective transport in Sosnowiec. The locations of ticket machines in Sosnowiec were presented, and the relationship between the number of departures from the bus stop and the value of tickets sold in ticket machines was analyzed. Based on the information presented in the article, the following conclusions can be drawn:

- in Sosnowiec, bus communication prevails, which may result from lower operating costs of this type of communication (compared to tram communication) and a denser network of roads than tram tracks,
- most of the bus lines are served by the operator PKM Sosnowiec, which may be due to the shares of the City of Sosnowiec in the share capital,
- in the area of Sosnowiec, there are the most normal lines, which run between 23-5 hours and serve all communication stops along the route,
- a passenger who wants to buy a communication ticket has a choice of several ticket distribution channels,
- the analysis showed that the factor 'the number of departures of communication lines serving the selected bus stop' has the greatest impact on the value of tickets sold in ticket machines in Sosnowiec. This may be because the more trips from a given stop, the more passengers decide to buy a ticket from the ticket machine.

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