DIFFERENTIATION OF ACCESSIBILITY BY PUBLIC TRANSPORT TO SELECTED SERVICES IN SZCZECIN

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The article presents issues related to the temporary accessibility of public transport to selected services. Among the analyzed services, where travel time was examined, there are indoor swimming pools, cinemas, hospitals and shopping centers. The time accessibility of the so-called closest distance method. Analysis of the accessibility of public transport to selected services shows the places where the accessibility by public transport is lower. The results of accessibility and deviation in time were presented in graphic form..

Keywords – accessibility; time deviation; GTFS; public transport; services

Introduction

Transport accessibility has been studied for years by scientists. At the beginning, basic spatial relations, i.e. human travel to work, were examined. Galton is considered to be the precursor and performer of the first map of temporary accessibility [1881]. A more advanced technique for testing potential accessibility was proposed by Isard [1954] and Hansen [1959]. Potential accessibility allows the study of spatial relationships based on the gravity method, which means that each destination to a greater or lesser extent affects other travel sources [Chojnicki, 1966]

In the last several years, more and more researchers are starting to deal with the issue of accessibility by public transport [Podoski, 1977]. Researchers are paying more and more attention to the increase in the number of public transport, with a constantly decreasing share of the number of people traveling by public transport. Also in recent years, more and more publications are starting to appear which focus on public transport, including the possibilities of its improvement through infrastructure investments [Goliszek, 2014a; Goliszek, 2014b; Goliszek, Połom, 2016a; Goliszek, Rogalski, 2014]. In recent years, more and more investments in Poland in public transport have been possible thanks to EU structural funds [Kołoś, 2007]. In Poland, most investments in urban transport are limited to replacing rolling stock with a newer one, and in rare cases the reconstruction or construction of a tram or metro line [Gadziński, Radzimski, 2015; Goliszek, Połom, 2016c; Kołoś, Taczanowski, 2016]. The GTFS data format [General Transit Feed Specification; Delmelle, Casas, 2012] has been useful in evaluating research on public transport investments in the city in recent years. In recent years, thanks to the GTFS data format, there have been more publications that relate to changes in the accessibility of public transport for various purposes. Researchers used this data format in their research into commute shopping [Widener et al., 2017], shopping centers [Farber et al., 2014], medical services [Neutens, 2015], culture and education [Allen, 2019; Martínez-Jiménez & Salinas-Pérez, 2019] and commuting [Goliszek, 2017a]

Case study and data

Szczecin is a provincial city located in the north-west of Poland with a population of approx. 400 thousand people. Information on the population in the city by age category has been made available by the Szczecin City Hall. These data were distributed proportionally to census circuits, which in Szczecin is 1869. With such a degree of detail, it has become possible to accurately estimate the number of people who live in areas remote from public transport services. GIS technologies and the use of GTFS data for several years have allowed to carry out transport research at a higher level of detail [Burdziej, 2016]. The GTFS data format was used by the author of the publication and by others for comparative purposes of the city in Europe [Goliszek, 2017; Goliszek, Połom, 2016; Poelman, Dijkstra, 2015; Stępniak, Goliszek, 2017; Stępniak et al., 2019]. The GTFS data format, which is made available by the public transport manager in Szczecin, allows you to make public transport models based on the timetable and road network based on OpenStreetMap data.

Research methodology

The research methodologist in the article is based on the temporary accessibility of the so-called closest distance to selected services. Analysis of travel time by public transport to services was made for fifteen-minute time ranges, at different times of the day depending on the service. At the access to hospitals, the analysis in Szczecin was done between 7 and 9 am. Access to shopping centers was made for 17-19 hours. However, for indoor swimming pools and cinemas, the time range of time accessibility analysis is between 18 and 20. Information on the average deviation of travel time for selected means the longest and shortest time for the selected range and service. Deviations in the operation of public transport for selected hours were made in two-minute intervals ranging from 0 to 14 together with the total number of people who live in areas where the deviation is greater than 14 minutes.

Time accessibility to services

The map of temporary accessibility to indoor swimming pools in Szczecin shows areas that are better and less accessible by public transport. The

worst access to the swimming pool is in the northern part of the North district. In the southern part of the West district, temporary access to indoor swimming pools is good, and slightly worse in the northern part. In the central part of the Prawobrzeże district there is good access to indoor swimming pools. In contrast, swimming pool access is much lower in the peripheral areas of the Prawobrzeże district. The best access to indoor swimming is in the Śródmieście district, it is the same center of Szczecin inhabited by a large number of people. A little worse access to the swimming pool is in the Śródmieście district in the industrial part, which is less often inhabited

In the diversity of temporal access to cinemas in the city, divided into districts, significant differences between districts are visible. In the Śródmieście district, where cinemas and the North district are located, there is a good time accessibility except for the bus route in the south of the district. In the West district, low temporal accessibility occurs in the northern part, and in the southern part there is a little better accessibility. On Prawobrzeg, access to cinemas is similar, as is access to indoor swimming pools. In the center of the estate there is good time accessibility and on the outskirts is much worse and access to the cinema is more time-consuming [Figure 1.]

Access to shopping centers is more dispersed than other travel destinations. In the Prawobrzeże district, the best time accessibility is in the center, worse on the outskirts. In the city, the southern part of the West district is easily accessible, and the northern part is less. The central part of the North district has good accessibility, which is rapidly decreasing, which is related to the linear route of public transport towards the center. The most accessible is the central part of the Śródmieście district, the industrial part of the district is a little worse, as shown in Figure 1.

The worst temporary access to hospitals is in the North district. Quite good time accessibility is in the West district. There is good accessibility on the right bank in the center of the district and in its eastern part. On other parts of the district in the so-called the peripheral part is worse travel time. The best time access to hospitals is in the Śródmieście district, in the residential part. Time accessibility is slightly lower in the industrial part of Śródmieście, near allotments.

Time deviation

The highest time deviations in public transport accessibility to the indoor swimming pools between 6:00 and 8:00 pm are observed in the northern part of Północ district. Similar significant deviations, yet concerning a much larger area, have been recorded for the eastern and the south-western parts of Prawobrzeże. In Zachód district time deviations have gained a medium level. The lowest time deviations in public transport accessibility are observed in the central part of Śródmieście, in the southern part of Północ district, the southern part of Zachód district and in the central part of Prawobrzeże district.

Fig. 1. Time accessibility
to selected services in Szczecin

The time deviations observed between 6:00 and 8:00 pm indicate that they are the highest in the western and south-western part of Prawobrzeże district as well as in the northern part of Północ district. The average time deviations have been recorded in almost entire Zachód district and in the southern part of Północ district. The lowest time deviations in travel times to the cinemas are observed in the central parts of Śródmieście and Prawobrzeże districts.

Time deviations in public transport accessibility to the shopping centres were analysed for the time period starting at 5:00 pm and finishing at 7:00 pm. The highest deviations are observed in the eastern part of Prawobrzeże district and in the northern part of Północ district. In Zachód district the deviations vary from place to place while in Północ district they are highly diversified. The lowest time deviations in public transport accessibility to the shopping centres have been recorded in the central parts of Śródmieście and Prawobrzeże districts and in the southern part of Zachód district [figure 2].

Time deviations in public transport accessibility to the hospitals were analysed for the time period starting at 7:00 am and finishing at 9:00 am. The highest deviations are observed in the eastern part of Prawobrzeże district and in the northern part of Północ district. Small time deviations have been recorder in the northern and central part of Prawobrzeże and in the southern part of Północ district as well as in almost entire Zachód district. The

smallest deviations are observed in the central part of Śródmieście district [figure 2].

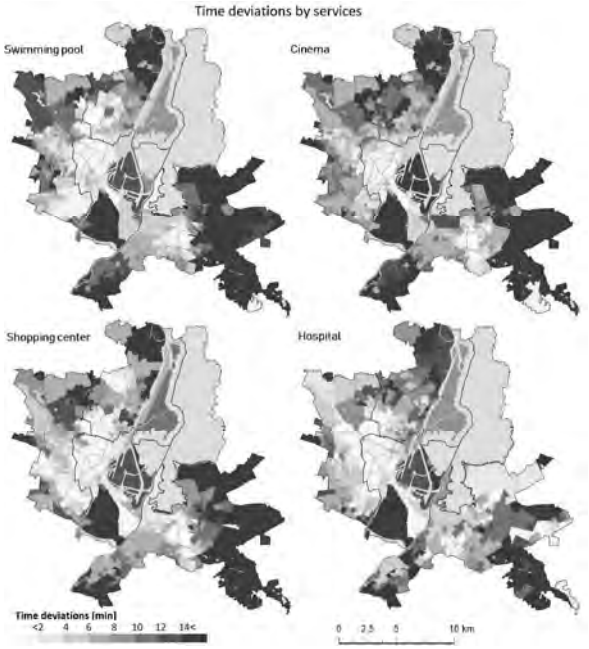

Fig. 2. Average deviations of travel time by public transport.

Conclusions

Variation in travel time to selected services depends on several things. The most important factor affecting the value of time is physical distance, the location factor of sources and destinations plays a key role in the value of time. The second important factor shaping the time distance is the choice of the means of transport. In this case, public transport was selected for the analysis, which is characterized by functioning according to a specific timetable, which means bus, tram and subway journeys occur at certain time intervals. Therefore, when calculating public transport journeys, the time it takes to get out of the house to a bus stop, a specific bus or tram, which operates according to a specific schedule, is very important. Wessel and Widener [2016] drew attention to this in their article. However, in the article by Stepniak et al. [2019], the authors pointed out that calculations performed at 15-minute intervals may give erroneous results. According to the authors of this publication, the appropriate time intervals for which the analysis is performed should be selected at random. This is to avoid a situation when we count the travel time just after the departure of public transport. The author of this article agrees with the statement of Stepniak et al. [2019], but believes that the use of a two-hour time interval, i.e. 9 time accessibility profiles at 15-minute intervals, differentiates time deviations, which illustrates well the deviations in public transport. Similar deviations were found by Goliszek and Połom [2016b], focusing in the article on temporary accessibility to the center of Szczecin, taking into account 5-minute intervals. Interesting results were also found by the author of this publication in another article in which he proved that the location of certain services is not in the immediate vicinity of large clusters [Goliszek, 2017b, Goliszek, 2019].

Acknowledgements

The short topic was created on the basis of the project: “Significance of transport accessibility components in Szczecin with particular focus on collective transport in the period of 2009-2018 [TraCoM]”, financed from the resources of the National Science Center granted on the basis of Decision No. UMO-2017/25/N/HS4/01237.

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