

Sławomir Goliszek, doctoral dissertation entitled „Significance of transport accessibility components in Szczecin with particular focus on collective transport in the period of 2009-2018”

Summary

This doctoral thesis deals with the importance of the components of transport accessibility in the city of Szczecin, north-western Poland, over the period 2009-2018, with particular attention to public transport. The study uses census districts to look at the accessibility of a range of destinations by both public and private (car) means of transport in 2018 and adds three other years, 2009, 2012 and 2015, for public transport alone. The empirical part of the study involved statistical methods and specific points in time in 2018, including date, hour and minute. The specific metrics used for the static data about each destination included: shortest distance, percentage of the population, cumulative accessibility, potential accessibility, potential quotient, and for the final outcome, a synthetic ranking metric with data standardisation. The dynamic part of the empirical research covers the entire study period, i.e. 2009-2018, supplemented by data on single days running from 5:00am to 10:00 pm. For the longer of the periods, the method of potential accessibility to population was used. The choice of methodology involved a review of various GIS tools and their applicability to city-wide accessibility research, including text format data (GTFS) covering several years. Each of the research methods employed was assessed for its impact on the individual components of transport.

Section I justifies the study area chosen. It also defines the subject, the terminology and the spatial and temporal scopes of the study. The section goes on to specify the GIS tools involved. Section II provides a description of the theory and a breakdown of the definitions and classification of urban transport. Additionally, it expands on the basics of the description of the components of transport accessibility and metrics, including highlighting a literature review on public and private transport. In Section III, descriptions are provided of the components of transport accessibility in the city of Szczecin broken down into the spatial, transport, temporal and individual components. Additionally, Szczecin is compared with the spatial and transport components of other port cities on the Baltic or the North Sea. The section also lays out stages in the development of a model of public and private transport using GIS tools (GTFS and the application of the Google Map API).

Sections IV to VII present empirical results broken down into the methods used for defining transport accessibility. Section IV details the first method of accessibility as the shortest distance to a range of selected services, including an indoor swimming pool, a cinema, a shopping centre and a hospital. This section also details areas with poorer accessibility and indicates their numbers of inhabitants. Points of differentiation of accessibility were indicated for public transport (due to transport timetables) and private car (due to road congestion and category) at the scale of the whole city. Section V discusses potential accessibility to the population by public and private transport in 2018. Both modes were compared with differences seen in terms of daytime accessibility (5:00am – 10:00pm). Section VI focuses on the demand-supply context using the potential quotient method. It presents the potential of workplaces vis-à-vis the potential of inhabitants of working age and the potential of places in educational establishments (nursery, elementary and secondary schools) against the population potential in the corresponding age groups: 3-6 years (nursery school), 7-15 (elementary school) and 16-18 (secondary schools). The potential quotient represents the ratio of the surplus of destinations to the surplus of departure points and may indicate points of increased traffic, both public and private. The last of the empirical sections, No. VII, analyses public transport accessibility at an interval of three years within

the study period. An extended analysis for each year permitted the inclusion of one of the components in the study (spatial or transport) and to determine the extent of change in transport accessibility depending on the impact of infrastructural (or organisational) change or change in the size of the population. Based on this, conclusions were drawn about the impact of Szczecin's Fast Tram (SST) on the change in overall transport accessibility in terms of each of the components. Average speeds were compared citywide for public transport during the day and change in the travel time and in number of people at peak hours. Additionally, all research methods were represented with a synthetic metric that consisted of standardised results of the component results for accessibility by public and private transport.

Section VIII summarises and synthesises the results of analyses presented in the empirical part of the work. Answers are proposed to the research questions and the research hypotheses are verified.

With respect to the first research hypothesis, it was confirmed that the level of accessibility by public transport in the centre-periphery pattern showed much greater variation both spatially and temporally (time of day) than that by private transport. The second phase addressed accessibility by public transport, which proved to be generally lower than by private transport. However, the differences between accessibilities by public and private transport diminished at peak hours thus increasing the competitiveness of public transport at these times. The greatest level of difference in accessibility between these two types of transport is at night, which proves the hypothesis right. The third hypothesis, namely that the greatest differences between public and private transport in cumulative accessibility of the workplace are to be found for rides of up to 30-minutes and those outside the strict city centre and even more so it was also confirmed in the peripheries, away from the tram network. The fourth hypothesis was about the dynamics of change during the study period. The city-centre's potential accessibility dropped, which was primarily explained as a consequence of a diminishing population in this part of the city. A change in overall potential accessibility in Szczecin was also confirmed. This included the lowering of accessibility in almost the entire city with the exceptions of rising levels limited to relatively small areas featuring a strong infrastructural effect combined with either an increase or just a slight drop in population. During the study period, some housing projects in the central district recorded around a 20 percent fall in their registered population. The fifth hypothesis covered new transport infrastructure projects delivered between 2012 and 2015, i.e. phase 1 of the SST and the integration of bus lines in the Prawobrzeże district with selected tram stops. The tram project did improve potential accessibility to the population of the district, despite the erosion of population in some other housing projects in Prawobrzeże district. The hypothesis was proven partly right. Indeed, while the district's housing projects (including Dąbie, Słoneczne, Majowe, Bukowo-Kłęskowo, Zdroje, Podjuchy and Żydowce-Klucz) lost some of their population, four of them (Dąbie, Żydowce-Klucz, Podjuchy and Zdroje) recorded an overall increase in accessibility and this could be explained by the new infrastructure. In response to the sixth hypothesis, it was found that during the study period some housing projects gained in population forcing the opening of new bus lines and improving accessibility. The study confirmed the hypothesis that in an area that gained in accessibility over the whole period and where a new bus line was opened between 2015 and 2018, that potential accessibility change was mainly caused by the infrastructure project. Hypothesis seven was partly confirmed in that for some destinations and some research methods the resulting accessibility distribution did not follow the typical centre-periphery pattern. The centre-periphery relationship depends on the location of the destinations and the method we use to determine accessibility. A clear-cut centre-periphery pattern tended to emerge when using the methods of potential and cumulative accessibility. On the other hand, when using the closest distance method, the greatest impact is made by the location of the nearest destination in the context of the road network and public transport. The last hypothesis, No. 8, posits that due to Szczecin's particular river and port layout and to the great distance between the left (western) and right (eastern)

bank districts, opportunities to travel between parts of the city on either bank of the river, by both public and private transport, are inferior to those in other port cities selected for this comparison which are dissected by a river and lie beside the Baltic or the North Sea. This hypothesis has been proven. The effect was explained by the low number of transport lines across the river and by the small number of road bridges.