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ID 1657 | ANALYSIS OF DYNAMIC PUBLIC TRANSIT ACCESSIBILITY IN WARSAW

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1 INTRODUCTION

Public transport plays an important role in functioning of every large city. It facilitates the flow of people and goods, and connects strategic areas of housing, labour, commerce or entertainment. Cities cannot develop properly when relation between those areas is not satisfactory. Public transport accessibility is a key factor to a stable operation of the whole system that city creates. It is generally understood as the ease of access to the means of transport and the ease of travelling to desired destinations. Concepts of the transport availability are used in the research on the settlement network, transportation systems and spatial development at every level (Olszewski, Dybiczyński, Śleszyński, 2013).

Public transport accessibility evaluation may significantly support management of city components of the city and whole transit network. The analysis should precede every major construction investment. It may also help local authorities intervene when current condition of public transport services is deficient in certain areas, especially housing developments poorly connected with public service areas and workplaces. Therefore, the following paper presents an attempt to assess a public transit time accessibility on the example of a medium-sized European city - Warsaw.

1.1 PUBLIC TRANSPORT SYSTEM IN WARSAW

Public transport system in Warsaw metropolitan area operates on the area of the city and 30 adjacent communes and covers about 2500 km² (517 km² in Warsaw and 1912 km² outside the city borders). The annual number of passengers exceeds 1 billion (Urząd m.st. Warszawy, 2015). The system consists of 267 bus lines, 26 tram lines, 4 city train lines (SKM) and 2 metro lines. Moreover, passengers who have appropriate tickets are able to use train lines operated by Masovian Railways (KM) and Warsaw Commuter Railway (WKD).

Important part in the public transport system is played by rail transport (railway, metro and tram), however bus is the most accessible mean of transport to the largest group of passengers. According to the data from 2013 it is estimated that during the year buses transported over 550 mln passengers, which is twice more compared to the number of passengers transported by trams or metro (Table 1). Tram is the second mean of public transport in terms of number of passengers. The third is metro (the youngest mean of transport in the city) which gains importance because of its capacity and travel time. Metro in Warsaw it is still under construction and the next 6 stations are going to be commissioned in 2019. In the peak time metro runs every 3 minutes. (Urząd m.st. Warszawy, 2015)

Mode of transport	Number of passengers [2013]
Buses	557 974 004
Trams	264 201 709
Metro	180 187 218
Railway – Fast City Rail (SKM)	22 578 235
Warsaw Commuter Railway	4 276 420
Railway – Mazovian Railroads (Koleje Mazowieckie)	30 043 675
Sum	1 059 261 261

Table 1 - Estimated number of passengers in 2013 divided into modes of transport.
Source: Urząd Miasta Warszawa, 2015

1.1.1 MODAL SHARE

According to data obtained during the travel survey of Warsaw inhabitants in 2015 nearly half of travels are made with public transport and one third of them with private vehicles. Almost 20% of trips are made on foot. After excluding the latter from the analysis the modal share occur as follows: 56.9% public transport, 38.6% private motor vehicle, 3.8% bicycle, 0.7% other means of transport. (Kostelecka, 2015b)

Every day inhabitants of Warsaw make 3.348.336 trips from which 44.1% comprise trips between home and workplace, 11.1% - trips between home and place of education, 35.1% - trips between home and other destinations and 9.7% - other trips with no connection to home. Majority of trips start and finish within the city boundaries and only 4.5% have their start or end outside it. Spatial layout of journeys shows that most of them take place on the west side of Warsaw (59.6%) and over one fifth (23.2%) requires crossing the Vistula river. (Kostelecka, 2015b)

The analysis of the data from years 1980, 1993, 1998, 2005, 2015 reveals the increasing value of inhabitants' mobility index in period 2005 - 2015, after a long period of decrease 1993-2005 (Kostelecka, 2015b). The cause of this increase is an ongoing process of development of rural areas in suburbs of Warsaw (urban sprawl) which is considered nowadays as one of the major problems in the city's spatial management.

Moreover, after the decrease of public transport share in 1980-1993 an inhibition of the decrease can be observed in years 1998-2005. It is the result of high expenditures to improve the public transport system and the competitiveness of it in terms of traffic congestion. On the other hand, in last 10 years public transport modal share dropped by almost 10%. Simultaneously the number of walking trips decreased from 30,1 % in 1980 to 17,9 % of all trips in 2015 (Figure 1). The cause of it is the increase of motorisation index and easier access to means of public transport (com. Figure 1).

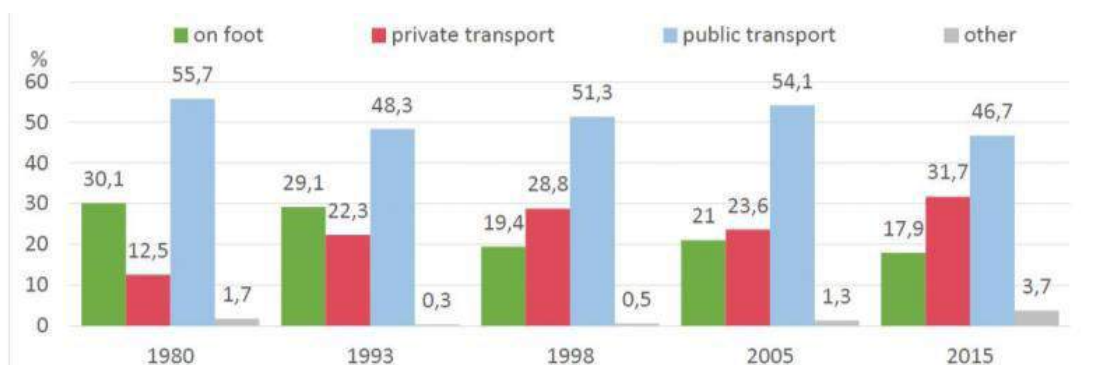


Figure 1 - Comparison of travel structure, by travel methods for travel in general. Source: Kostelecka, 2015b

The study of traffic volume conducted in 2015 (Kostelecka, 2015b) provided the numbers of cars within the metropolitan area. It is estimated that during a working day about 1 million of cars cross Warsaw borders as well as central area of the city (in both directions); 550 thousand of cars come from metropolitan area and 450 thousand from outer area. Furthermore, a significant rise of the motorisation index can be observed, which results in an increasing modal share of individual motor vehicles starting from the end of 1980s (Kostelecka, 2015b). According to the data published by Central Statistical Office in 2012 there were 580 vehicles per 1000 inhabitants in Warsaw, whereas in the 90's there were less than 400 cars. Similarly the index of motorisation raised in counties adjacent to Warsaw. For example, in Warsaw West County there were even 612 vehicles per 1000 inhabitants in 2012 (Urząd m.st. Warszawy, 2015). Increasing motorisation index and less access to public transport in communes outside Warsaw result in 59,9% share of cars (and only 29,6% of public transport) in all trips made by inhabitants from these areas (Kostelecka, 2015). These are the reasons for high traffic congestion during peak time in Warsaw. According to TOMTOM Traffic Index list Warsaw was ranked 42nd most congested city in the world (TomTom, 2017).

Cars are one of the main causes of air pollution in the city. According to Voivodeship Environmental Protection Inspectorate (WIOŚ) linear sources in the total pollutant emission share in Warsaw is the highest for nitrogen dioxide and particulate matter - PM10. The highest concentration of pollution occurs in vicinity of the roads of high traffic density and areas with dense development, especially in the city centre. A similar problem affects the whole metropolitan area where in 2011 according to Supreme Audit Office (Najwyższa Izba Kontroli, 2014) 63% of total PM10 emission from this zone was caused by linear sources (mostly transport). Moreover, a big number of motor vehicles in the city results in noise pollution. In fact, Warsaw is claimed to be one of the most polluted cities in Poland in terms of the number of people affected by overscaled noise and the area in which acceptable noise pollution index is exceeded (Warsaw City Council, 2015).

1.2 METHODS OF PUBLIC TRANSPORT ASSESSMENT AND ITS INSERTION INTO PUBLIC SPACES

Public spaces are one of the most significant components of urban environment. Not only are they important for social reasons but also influence the functionality of public transport system. Hence, authorities responsible for creating, managing and enhancing such system (including local government, urban planners, transport engineers, etc.) should introduce proper tools and methods of assessment of public transport accessibility. Since GIS become more and more common as an aid in different public governing areas, it seems obvious that methods of assessment of public transport accessibility will also be implied through such systems.

Cities around the world use different methods to study and analyse their public transport systems. They are usually based on evaluating time of accessing the public transport or distance between the stations and locations of residence (Fransen K. et al., 2015). Nevertheless, many other substantial factors may be taken into account to receive more precise view of a particular public transport system. For instance, PTAL (Public Transport Accessibility Level), a method introduced in London and then implemented in other British cities after modifications (GMAL, Greater Manchester Accessibility Level) consists of evaluating

time to get to public transport station from a defined Point of Interest and waiting time based on time tables (Measuring Public Transport Accessibility Levels, 2010). Welch and Mishra (2013) during their research on Washington-Baltimore region multimodal transport system and its impact on the environment added the factor of importance of the stations. They analysed the public transport frequency in peak and off-peak periods. The element that significantly improves the public transport accessibility assessment is evaluation of the time or cost of the journey to the defined destinations. Research on public transport vs. private car accessibility estimation in Tel-Aviv metropolitan area (Benenson et al., 2011) included walking time from the origin to a stop, waiting time, summarised journey time (travel times and waiting times between different buses) and walking time from the final stop to the destination (employment areas and other urban functional areas). Through GIS tool Urban.Access, developed by the researchers, the BTT (Bus Travel Time) was compared with CTT (Car Travel Time). Previously mentioned Lei and Church (2010) noticed that including estimated travel time into public transport accessibility assessment may occur insufficient. The value fluctuates depending on timetables. Including this factor into public transport accessibility assessment methods demands sophisticated GIS analyses implied into a specific public transport system.

Introduction of public transport accessibility assessment methods in other cities and enhancing them in existing ones pose a significant challenge for local authorities and specialists. It may help them recognise transportation service deficient areas and reshape the system accordingly.

2 METHODOLOGY

The main aim of the study was to analyse the quality of Warsaw public transport service. The model of public transport created on the basis of the total travel time to the city centre or to the key, centre-forming destinations enables identifying areas which are insufficiently serviced yet densely populated.

In order to measure the accessibility of public transport in Warsaw, it was crucial to identify key areas within the city spatial layout which are frequently attended by inhabitants. Those areas play important role in the city structure as they ensure workplaces, trade, education, recreation and community interactions. During the study points which represent district (major) centres and local (minor) centres were selected in every district of Warsaw.

The most significant part of the city is undeniably the city centre. In Warsaw it encompasses the area of the inner district Śródmieście and parts of adjacent districts: Wola, Ochota, Praga Południe and Praga Północ (the last two located on the right side of Vistula river) (Warsaw City Council, 2006). This area concentrates main government and local authorities' offices, embassies, international institutions and nationwide agencies as well as commerce, education and cultural objects (including historic Old Town and New Town). Multiplicity of key destinations within the inner city did not allow to select one central point of Warsaw, instead several points on two hierarchical levels were chosen (Table 2).

In the urban environment, apart from the inner city, it is possible to distinguish district and local centres. The first are usually anchored by local government seats, shopping malls or education institutions, especially universities. Such places attract not only residents of particular district but also from other parts of the city. According to the local planning act (Urząd Miasta Warszawy, 2006) district centres should be located suitably in the district layout, easily accessible and well connected with the city centre and housing developments. At this point, the fact that transport hubs influence strongly the city environment and often become district centres must be highlighted.

Local centres can be defined as multifunctional areas dedicated to residents of particular districts, which provide them with various services including retail, healthcare, education, culture as well as places of recreation and community integration (Oddział Warszawski Stowarzyszenia Architektów Polskich, 2015). Such areas, usually located between housing developments and public transport stops, aim their amenities mainly at local residents. Local centres were determined on the basis of "Warsaw Local Centres" project conducted by Association of Polish Architects in which areas of natural social interactions in the city's spatial layout were selected (Oddział Warszawski Stowarzyszenia Architektów Polskich, 2015).

Table 2 presents the list of important points distinguished from the urban space of Warsaw. They are divided into two groups based on their place in hierarchy of district and local centres and sorted by districts on each side of the city. Figure 2 shows the location of selected points.

West side of Warsaw	
<p>1) Bemowo District Centre: 1) District Council of Bemowo Local Centre: 1) Department store <i>Hala Wola</i>; 2) Wrocławska bazaar; 3) Supermarket <i>Stokrotka</i> at Radiowa St.; 4) Bemowo shopping centre</p>	<p>9) Włochy District Centre: 1) Railway station Włochy; 2) Shopping centres at intersection of Popularna St. and Jezozolimskie Ave.; 3) Shopping centre Okęcie Local Centre: 1) Bakalarska marketplace; 2) Community centre <i>Artystyczny Dom Animacji</i></p>
<p>2) Bielany District Centre: 1) District Council of Bielany, 2) Józef Piłsudski University of Physical Education, 3) Cardinal Stefan Wyszyński University Local Centre: 1) Sales and service centre at Conrada St., 2) Department store <i>Megasam Żoliborski</i>, 3) Metro station <i>Stare Bielany</i>, 4) <i>Wolumen</i> bazaar</p>	<p>10) Wola District Centre: 1) District Council of Wola; 2) Daszyński Roundabout; 3) Wola Park shopping centre Local Centre: 1) Sales and service centre at Górczewska St.; 2) Bazaar at the Koło neighbourhood; 3) Former cinema <i>Kino Femina</i></p>
<p>3) Mokotów District Centre: 1) <i>Galeria Mokotów</i> shopping centre, 2) Warsaw School of Economics Local Centre: 1) Broniewski Orsza Square, 2) Jordan garden at Odyńca St., 3) KADR community centre, 4) Wałbrzyńska bazaar, 5) <i>Land</i> shopping centre</p>	<p>11) Żoliborz District Centre: 1) Wilson Sq. Local Centre: 1) Department store <i>Hala Marymont</i>; 2) Grunwaldzki Sq.</p>
<p>4) Ochota District Centre: 1) Narutowicz Square, 2) Szczerbiński park (skiing slope), 3) <i>Redota</i> shopping centre Local Centre: 1) Department store <i>Hala Banacha</i>, 2) <i>Moldawska</i> marketplace</p>	East side of Warsaw
<p>5) Śródmieście District Centre: 1) surroundings of intersection of Jezozolimskie Ave. and Marszałkowska St.; 2) <i>Złote Tarasy</i> shopping centre; 3) Metro station <i>Ratusz-Arsenał</i>; 4) Krakowskie Przedmieście St. nearby Warsaw University; 5) Plac Zamkowy in front of The Royal Castle in Warsaw; 6) National Museum in Warsaw Local Centre: 1) Department store <i>Mirówskie Halls</i>; 2) Savior Square; 3) Union of Lublin Square; 4) <i>Arkańdia</i> shopping centre; 5) Warsaw University of Technology</p>	<p>12) Białołęka District Centre: 1) District Council of Białołęka Local Centre: 1) Sales and service centre at Światowida st.; 2) Shopping centre at Modlińska st.</p>
<p>6) Ursus District Centre: 1) Railway station Ursus; 2) District Council of Ursus Local Centre: 1) Acher Park; 2) Plac Tysiąclecia; 3) Sales and service centre at Wojciechowski St. (nearby Park Hassów); 4) <i>Skoroszy</i> shopping centre</p>	<p>13) Praga Południe District Centre: 1) Wiatraczna Roundabout ; 2) PGE National Stadium ; 3) District Council of Praga Południe Local Centre: 1) Sales and service passage at Francuska St.; 2) Shopping centre nearby Szembeka Sq.; 3) <i>Promenada</i> shopping centre</p>
<p>7) Ursynów District Centre: 1) District Council of Ursynów Local Centre: 1) Metro station Stokłosy - Ursynowski Shopping arcade; 2) Metro station Natolin - Galeria Ursynów shopping centre; 3) Metro station Kabaty - Tesco supermarket; 4) <i>Na Dolku</i> marketplace; 5) supermarket Auchan Puławska</p>	<p>14) Praga Północ District Centre: 1) Metro station Dworzec Wileński; 2) Plac Weteranów 1863 r. (entrance to The Warsaw ZOO) Local Centre: 1) Haller Square; 2) Różycy bazaar</p>
<p>8) Wilanów District Centre: 1) District Council of Wilanów ; 2) The Wilanów Palace Local Centre: 1) Center of Divine Providence (Centrum Opatrzności Bożej)</p>	<p>15) Rembertów District Centre: 1) District Council of Rembertów; 2) Railway station Rembertów Local Centre: 1) War Studies University</p>
	<p>16) Targówek District Centre: 1) District Council of Targówek Local Centre: 1) <i>Renova</i> shopping centre ; 2) Trocka bazaar ; 3) Wiecha Square (in front of <i>Rampa</i> Theatre)</p>
	<p>17) Wawer District Centre: 1) District Council of Wawer (nearby railway station Międzyzłesie) ; 2) Children's Memorial Health Institute Local Centre: 1) Local community centre Marysin ; 2) <i>Falenica</i> marketplace</p>
	<p>18) Wesoła District Centre: 1) Railway station Warszawa-Wesoła ; 2) District Council of Wesoła Local Centre: 1) Sales and service centre at intersection of Brata Alberta St. and Wspólna St. ; 2) Sales and service centre at Trakt Brzeski</p>

Table 2 - District and local centres in Warsaw Source: own study

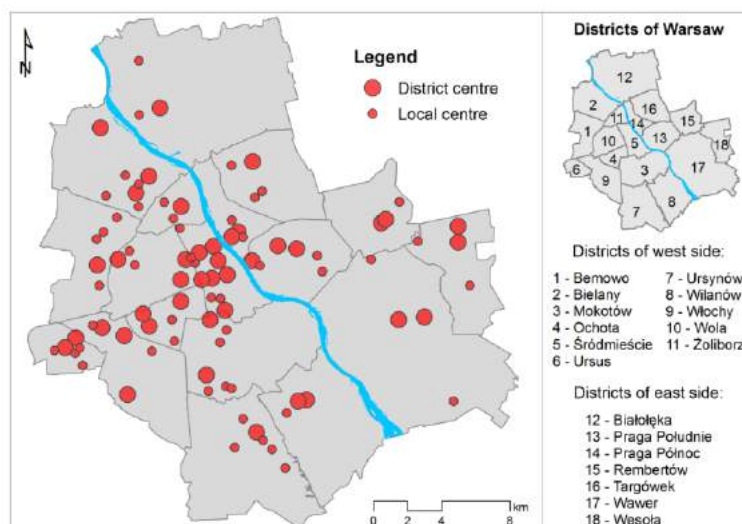


Figure 2 - District and local centres in Warsaw. Source: own study

2.1 MODEL OF WARSAW PUBLIC TRANSPORT

Model of public transit used in the study was based on data in the General Transit Feed Specification (GTFS) – a standardised data format for storing public transit routes, stops, and schedules (Morang, 2017). GTFS data is used e.g. in Google Maps transit trip planning or other planning applications. Since 2008 the number of transit agencies sharing open schedule data in common format increased from barely dozen to over a thousand agencies from almost every country around the world (Czebotar, 2017). Many major public transit systems, especially operators in US, have made up-to-date GTFS data for their systems readily available for download. Open-data movement also contributes to producing schedules in GTFS format, commonly available from a dedicated feed registry list (Transitland, 2017).

Public transit accessibility was evaluated using schedule-based transit analyses in ESRI environment. Tool “Add GTFS to a Network Dataset”, created by Melinda Morang, allows adding GTFS data to an ArcGIS network dataset and performing schedule-aware analyses using ArcGIS’s Network Analyst extension (Morang, 2017). GTFS schedule data for Warsaw was obtained from website Transitart (Inovatica, 2016). Network dataset was built using source point features (stop locations) and line features (roads obtained from Database of Topographic Objects - BDOT). Evaluation of public transit accessibility was performed using service area layer from Network Analyst extension. A network service area is a region that encompasses all accessible streets within given time breaks and is calculated on the basis of given cost - in the following study travel time with transit (ESRI, 2017). Accessibility was measured on the basis of travelled time, which is crucial for assessing public transit quality. The average travel time by public transport in Warsaw differs in years 1980 – 2015 and estimates 33 minutes in 2015, which is close to 30 min benchmark proposed in several studies (Cox, 2012; Goliszek & Połom, 2016). On the other hand, travel time between house and work destinations, the most often motivation of trip by public transport, was the highest of all motivations and estimated for 40 minutes in 2015. Moreover, the number of trips longer than 45 min, which is a limit time value of travel between city areas, was the biggest in this group (Kostelecka, 2015; Warsaw City Council, 2015). The methodology of the study was based on detailed positioning of isochrones of access in 5 minute intervals. Isochrones covered 15 min, 30 min, 45 min, 60 min and 90 min travel time to the destination. Calculation model is presented in the Figure 3. The test performed within morning rush hours, 6:00 – 9:00, on a working day.

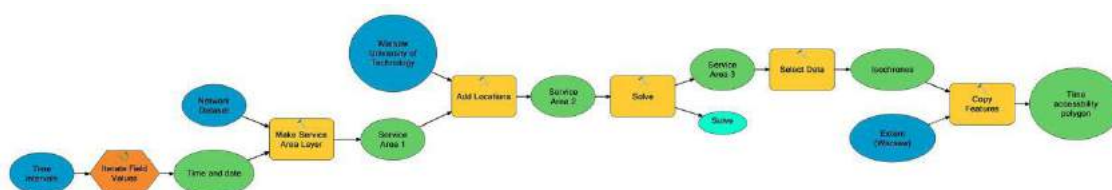


Figure 3 - Model for calculating isochrones in given intervals. Source: own study

Deviations in the operation of public transport were analysed using population data from 2011, derived from geostatical portal (<http://www.geoportal.gov.pl/>), divided into census blocks. The area of high population density was later used to select areas characterised with high population density and low public transport time accessibility. To obtain this, travel time and population data were standardised and summed, resulting in the indicator of the public transit time travel quality. Areas where average travel time was lower than 30 min were classified as satisfactory from the point of view of public transport handling. Public transit time accessibility indicator was classified using method of Natural Breaks into three classes (Figure 6).

The next question considered analysing accessibility of district and local city centres. Basing on the map of recognised areas (Figure 2), created isochrones covered travel time to the nearest destination in 10 min intervals (10 min, 20 min, 30 min, 40 min, 50 min, 60 min). The performed test included travel time towards facility, at 9:00 am, on a working day (Figure 7).

3 RESULTS

The results of service area analyses show differing public transit accessibility at following time intervals (Figure 4).

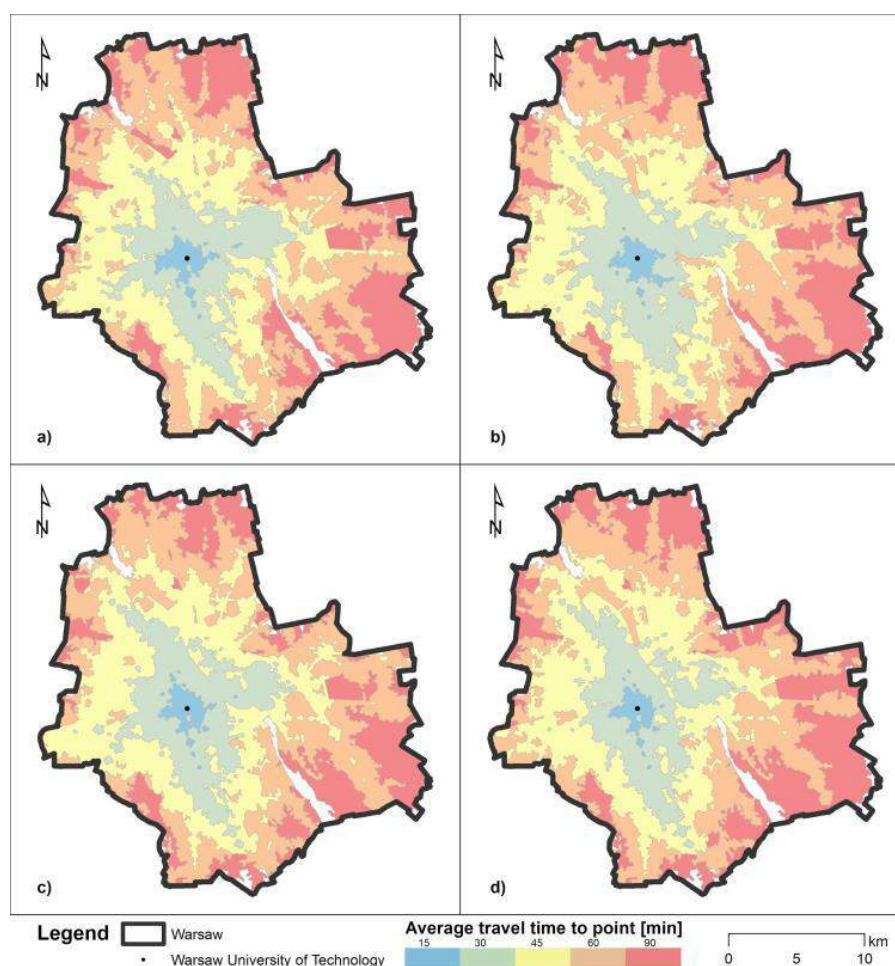


Figure 4 - Public transit time accessibility at 6:00 (a), 7:00 (b), 8:00 (c) and 9:00 (d) on working day. Source: own study.

Differences in time travel can be observed on the borders of the intervals. To obtain quantitative assessment of public transit accessibility in morning peak, the average travel time isochrones were calculated on the basis of raster isochrones in 5 min intervals in period 6:00 - 9:00 (Figure 5).

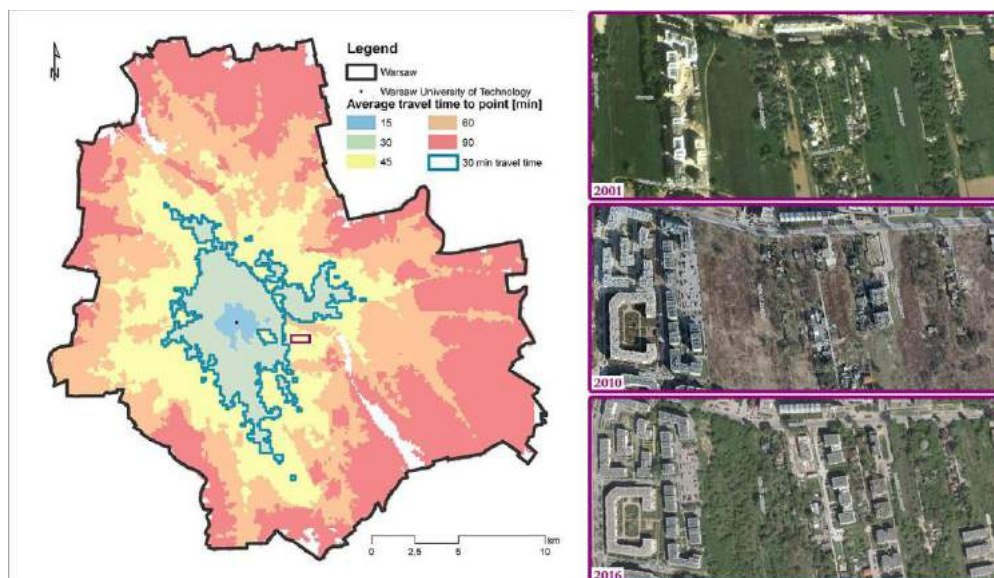


Figure 5 - Public transit average time accessibility in morning peak on working day. On the right: Czerniakow area in Mokotow district. Source: own study, <http://www.mapa.um.warszawa.pl>

Map of average travel time isochrones to city centre in the morning peak shows that the area of the lowest, 15 min travel time, is relatively small and covers area that can be also reached within 30 min walking distance. The satisfactory, 30 min travel time area covers both sides of the river. However, Vistula river is a visible barrier for public transit accessibility. In general, right side of the river has lower level of transit service to the city centre, located on the west side of the river. Strong influence of the metro lines and rail transport can be observed. Outside their service, the average travel time from the external parts of the city reach up to 90 min and higher.

Area with a lower time accessibility to the city centre, but still within a close distance, can be generally divided into two groups. First group includes areas closed for public transit, such as airports, railways, cemeteries, parks or industrial areas. The second group consists of new, rapid developments - attractive in the terms of location, nevertheless, not able to provide sufficient public transit service. Czerniaków, part of the Mokotow district (Figure 5), is exceptionally negative in the context of travel time. Located only 3 km from the city centre, but with 45 min average travel time, is intended for new, intensive housing investments.

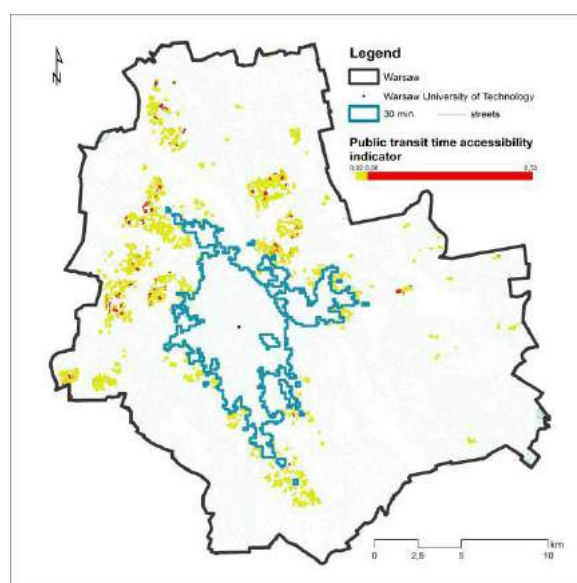


Figure 6 - Public transit time accessibility indicator. Source: own study.

Outside the area of 30 minute average time travel to the city centre live 1 283 875 residents of Warsaw, which gives 74% of total Warsaw population. Area of acceptable (30 min) time accessibility covers only 10% of city area. With the use of public transit time accessibility indicator highly populated areas, with significant travel time to city centre could be assigned. These are mostly observed in large-panel system building settlements on the north of Warsaw (Chomiczówka in Bielany district, Bemowo, Praga Północ, Białołęka). Low quality of transit service was also observed in western edge of Ursus district and in Ursynów district, despite their rail connection with the city centre (Figure 6).

Second part of the study consisted of identification and analysis of public transit accessibility of district and local centres (Figure 7).

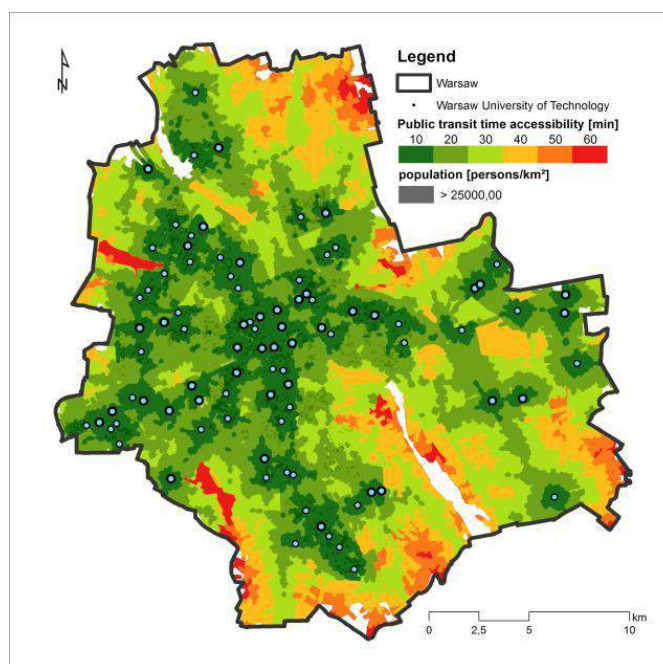


Figure 7 - Public transit time accessibility to district and local centres at 9 am on a working day. Source: own study.

The map shown in Figure 10 presents district and local centres localisation and the time of accessing them from every place in Warsaw at 9 am on a working day. It may be clearly noticed that the centres are distributed unevenly. An aggregation of them occurs in the centre of the city and along the major transit routes, where the access time approximates 10 minutes. Satisfactory results also cover more remote areas, such as Ursus and Włochy districts and areas with metro line stations. However, many service deficient areas may be also indicated. They usually cover developments placed away from major transit routes and close to Warsaw borders. Nevertheless, critical areas such as part of Mokotów district near Vistula river (e.g. Czerniaków, mentioned before) or Rembertów and Targówek localised relatively close to the city centre also have excessive access times to district and local centres. Such state is partially determined by the lack of the centres in those areas and improper public transport connection between them and the closest centres. Another peculiar phenomenon is the differentiation of the public transport time accessibility to district and local centres on both sides of Vistula river. The number of the centres on the west part of the city is far higher and the distribution of their localisations is more regular.

4 DISCUSSION

The source data processed in the study may be characterised as generalised and approximate. This is the reason for many limitations affecting the outcome. First of all, the analysis refers to a 3-hour period of time during a single day. Timetables are the input data for public transit course. Therefore, the study do not consider real time situation, traffic jams and unplanned schedule variances caused by unforeseen events. What is more, the population statistics from 2011 census do not show precisely the real distribution of inhabitancy and, even more importantly, do not fully correspond with the analysed schedule from 2016. Another important factor that has an effect on the results of the study is spatial data limitations.

Visualisation and storage of spatial data requires its proper classification, normalisation and generalisation. Localisation of local and district centres is represented by point symbols. Their spatial approximation affects the process of evaluation of their public transport accessibility. In addition, designated walking routes do not consider spatial barriers such as development fencing. Bus stop access times are affected because of this limitation. It is also important to take into notice the fact that population density distribution data processed in this study is classified into polygons that define statistical circuits. The results of the study are highly determined by the way the data are gathered and classified.

Visualising processed data on maps enables analysing many relations and phenomena. The distribution of the local and district centres in relation with the development areas or population statistics may be analysed. The spaces that are deficient in the centres may be designated. However, studying the centres localisations the observers are unable to conclude if they fulfill their role. Although the method of assessing public transport accessibility applied in the research served to evaluate the time to get to district and local centres, it does not give a full insight into real time journeys not connected with job or studying destinations and afternoon local centres traffic peak. The assessment results indicate variance in journey time in different hours, over 30-minute accessibility areas, public transport service deficient areas and potentially well communicated areas but lacking in compact development.

5 CONCLUSIONS

Historical conditions of shaping Warsaw (substantial settlements were located in the distance from the city centre) have a great impact on the present transportation problems. The connection between localisation of neighbouring developments and the course of the major transit routes is noticeable. The data concerning the size of traffic jams and the number of cars coming to Warsaw every day (Warszawskie Badanie Ruchu, 2015) shows the significance of carrying out such studies and manage metropolity transport policy properly. Traffic jams are one of the major issues in Warsaw and a significant challenge for its development. Investigating travel time with public transit might give an insight and a potential answer to understanding travel behaviour of the city inhabitants. What is more, expanded analysis of public transport accessibility in Warsaw may make for a strategic tool in creating spatial policy integrated with development of transport infrastructure. It is a significant element of sustainable development, introduction of which may determine stable growth of the city. That is why usefulness and applicability of the data on public transport level may be improved considerably by sharing the data for free. Local authorities, investors, scientific researchers and social activists may produce different types of information from the data and apply it in the realisation of their undertakings. Furthermore, such initiatives may lead to creating information bank accessible for everyone.

There is a noticeable deficiency of district and local centres in the new developments. It may be caused by poorly prepared services programme for the dwellings and the emphasis on the financial effectiveness of the investments. Secondly, the centres overlap transport nodes and well communicated areas. There is no certainty whether the centres emerged first and the transport accessibility was ensured then or inversely. Future public transport policy should be proactively managed in relation with localising new centres. Local authorities also have to take into consideration analyses of scientific researchers such as SARP (Polish Architects Association) and local community suggestions. These sources of information may enrich the knowledge of the authorities about the condition of public transport and possible solutions to its enhancement. Formation of spatial policy in such cities as Warsaw requires equipping every development unit with proper services including public transport system. When the system seems to be insufficient to connect the area with the central part of the city, local and district centres pose a crucial role there. Districts such as Włochy or Ursus confirm the thesis. Although their accessibility to city centre is poor, local and district centres are easily available for the dwellers.

The areas assessed as well serviced are those where the access time to the city centre does not exceed 30 minutes. In other ones the public transport system is characterised as insufficient. Constant occurrence of traffic congestion indicate that public transport in Warsaw may not be enough attractive to combat the problem. On the other hand, ongoing development of metro line is a hope for a change in the adverse state. The problem may lay in the fact that spatial planning in Warsaw is not properly integrated with PT development. The law favours quickly performed investments set to financial benefit of the developer. Therefore, many low serviced areas emerge on the city surface and the costs of equipping them properly become much higher.

Areas with high population density and simultaneously low public transport time accessibility were characterised as low service areas, insufficient in terms of public transit quality. These were parts of the city with great population density, therefore significant in terms of handling a municipality. It is possible to analyze new public transport investments' impact on accessibility of public transport in different city areas. Extension of the second metro line in Warsaw is considered to have a great effect on public transport accessibility in many areas, among which there are many low service areas at the moment. It is very important to extend further studies to suburban areas, since they are housing a large number of people employed in Warsaw.

In conclusion, the quality of public transport poses a significant element of the condition of the city in general. Therefore, the public transport system should be included in spatial policy and integrated with its other components. Then, new dwelling investments would be preceded by the development of transport network. Such order of completion of new dwelling projects may make the process much more effective. The areas of most critical level of public transport accessibility in Warsaw (localised close to the city centre, densely populated, with over 30 minute access time to the city centre) cover the area of the new-built metro line. It may be a partial solution to the problem in those places.

The research presented in this paper shows how crucial for proper functioning of the whole city is well organised public transport. Such studies should be implemented into spatial policy of Warsaw. The scope of the analysis, however, should be extended. Other factors, such as localisation of suburban areas, planned public transport and building investments or new traveling trends, as well as real time data should be taken into account. Enhanced research may help evaluate the condition of public transport in Warsaw more precisely and enable local authorities to implement suitable instruments to improve the whole system.

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ID 1683 | RECLAIMING STREETS AS PLACES OF DIALOG: CAR-FREE SUNDAYS IN ISTANBUL AS AN EXPERIENCE OF SOCIAL DIMENSION OF TRANSPORTATION

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1 INTRODUCTION

In parallel with the economic, environmental and social problems in the world, tendency for alternative and sustainable transportation approaches have increased. As a solution to these problems, people-centred and sustainable transportation policies are developed on the bases of their successful and permanent results in long term. This study, discusses streets as spaces of dialog by focusing on social dimension of transportation. Existing trend changes in transportation, which considers human movements and accessibilities as their focus rather than vehicles are questioned in local scale. In this context, the study introduces experience of Istanbul in Turkey concerning the social dimensions of transportation in order to reclaim the streets as public spaces for dialog. The study conveys the experiences of Carfree Sundays events in Istanbul in order to discuss the reflections of people-centred transportation approach and its socio-spatial effects on streets.