ANALYSIS OF ELEMENTS OF THE ACCESSIBILITY WITHIN THE CITY OF WROCŁAW

Katarzyna Siła-Nowicka[1]

Abstract

GIS has a major impact on the restructuring of public transport, creating a modern and efficient traffic management system, which was based on demographic data and analysis of changes in the direction of travel.

The paper presents a brief history of the city's transport network in Wroclaw. It shows the trend of the network based on the city's development strategy, and presents opportunities for the development of communication networks based on application of GIS-solutions. In the paper there are suggested ways of conducting spatial analysis of geographic data, discussing the methods of their visualization.

In the research part of the paper there is a number of studies showing the current state of public transport network in Wroclaw and their cartographic visualization in the form of cartograms, maps of isochrones, as well as coverage maps. Performing the analysis and visualization contribute to the development of spatial data infrastructure and enrich knowledge on the possibility of a regular user what gets people to open up to the new technology.

It was found that the use of GIS-solutions in the studies analyzing the structure, bandwidth and other characteristics of communication networks in large cities provide support to simplify and modernize the economy for the area which is public transport.

Keywords

Urban transportation, GIS in transport, bus, tram

1 INTRODUCTION

Traditionally, the focus of urban transportation has been on passengers as cities were viewed as locations of utmost human interactions with intricate traffic patterns linked to commuting, commercial transactions and leisure/cultural activities. However, cities are also locations of production, consumption and distribution, activities linked to movements of freight. Conceptually, the urban transport system is intricately linked with urban form and spatial structure. Urban transit is an important dimension of mobility, notably in high density areas.

Public transport comprises all transport systems in which the passengers do not travel in their own vehicles. It is also called public transit or mass transit. While it is generally taken to mean rail and bus services, wider definitions would include scheduled airline services, ferries, taxicab services etc. — any system that transports members of the general public.

For the purpose of this paper according to the area of research which is Wrocław there were taken under consideration only trams and buses.

2 HISTORY OF PUBLIC TRANSPORT IN WROCŁAW

2.1 HISTORY OF THE TRAM NETWORK

The history of trams in Wrocław started in the end of 19th century. In 1876 there was founded Wrocław Society of Street Railway, which had a license for building the net of horse trams. A year later there was running first line from Krasiniskiego street to the Zoological Garden. First electric tram in the area of the contemporary Poland, was created in Wrocław in 1893.The same year there were constructed two depots and two power stations. Since that time there have been many societies and companies which have extended tram routes and developed public transport in Wrocław (Breslauer Verkehrsbetriebe – BVB, Breslauer Strassen-Eisenbahn Gesellschaft etc.)[1].

In the period of the Second World War many tram routes were badly damaged. Because of use all of gas supplies for the war purpose, trams had to take control over passengers from buses and private cars. In the end of 1943 all trams were reorganized in case of effective use of whole stock. All of trams were redirected to the city center and main railway station. Some of wagons were used as a health coaches for transporting wounded. During of siege Festung Breslau the barricade were built from trams. After the end of the war both, the tram stock and the tram net were devastated. Slight part of the trams were renovated, the rest fitted only to scrap, what contributed to the longterm rehabilitation of former glory of the Wroclaw tram network.

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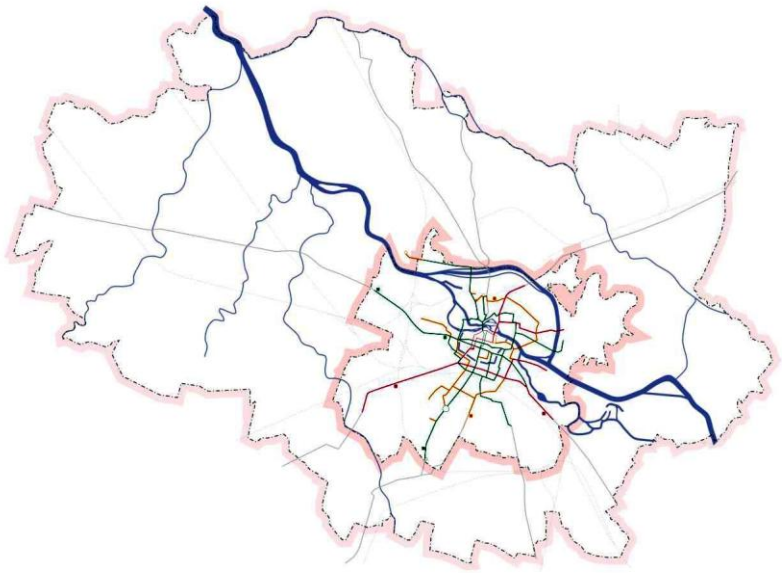


Fig. 1 *Network of trams in Wroclaw before the Second World War*

First tram in polish Wrocław run 22 of July, it was tram number 1, from the district Biskupin to the Railway Station Nadodrze. During the next quarter there were moved 24 tram lines. In 1947 run first night tram, and then they were running until the end of 2003. To the year 1990 whole of the tram network was rebuilt. The latest renovations stocked. Few new routes were to be done before 2003 but as always there were many difficulties and delays.

In the time of the flood in 1997, what was 120 years after first horse tram run through the city, whole stock was endangered. Most oh the trams were aligned Hallera street. Under the water there were over 23 km of rails, cataclysm brought a loss of 100 million złotych.

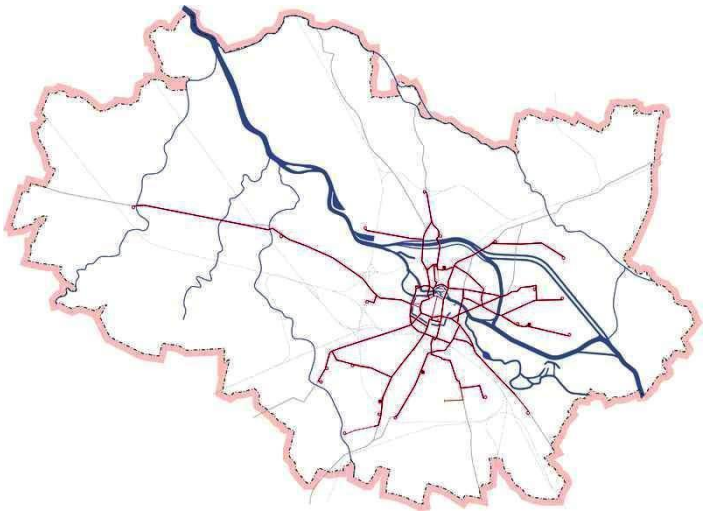


Fig. 2 *Network of trams in Wroclaw in the presence*

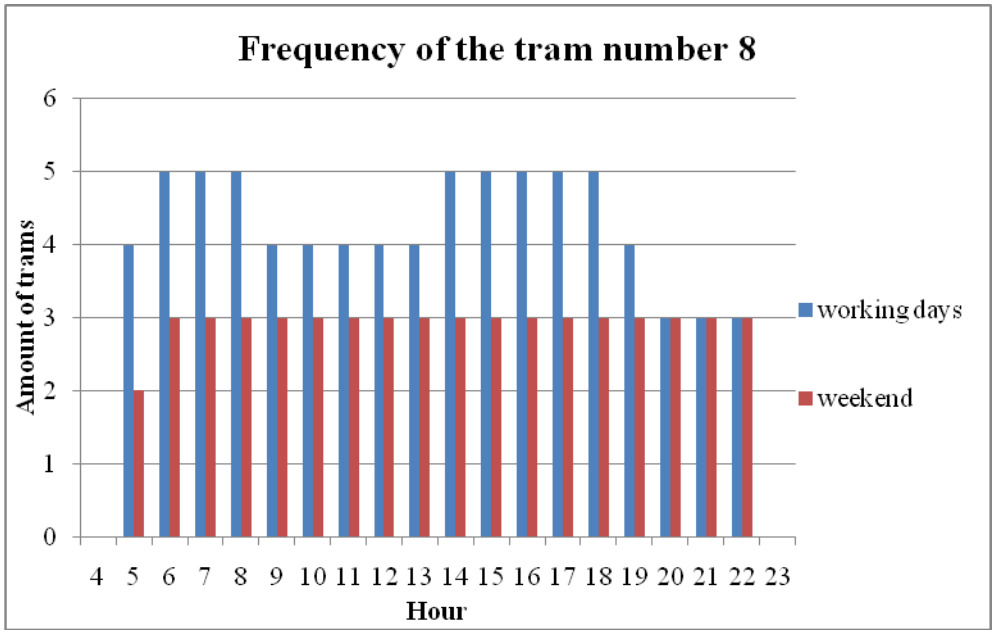
2.2 HISTORY OF THE BUS NETWORK

Wrocław was one of the biggest cities in the 19th century Europe and in that time it experienced development in the line with technological progress. The history of Wrocław's public transport reached to 1840, when on the route from the main square to the village Popowice run first horse omnibuses. They were running until the end of 1913. In 1924 busses started to run with the timetable. In the period of the Second World War many buses were used for transportation of the army so majority of the stock was destroyed. From 137 units from the period before the war it left only 7. From that moment year by year bus public transport has been developing and improving transporting solutions.

3 PUBLIC TRANSPORT AND ITS ACCESSIBILITY

In today's Wrocław there are about 120 trams running around the city according to their schedule. Trams in the capital of Dolny Sląsk are running from 4 am to 12 pm in working days and in the weekends from 5 am or 6 am to 12 pm. The average frequency in an hour it is from 12 to 15 minutes in rush hours to 20 in the rest period of the day.

During weekends trams run with the frequency of 3 for an hour, so we have the one each 20 minutes. Only in the beginning of the day when trams are leaving their depots this schedule looks differently. On the graph 1 it is shown the frequency of running trams on the example of a tram number 8.



Graph 1 *Frequency of the tram number 8 in the area of Wrocław*

There are 298 tram stops (both sides of the routs), what means that there are about 140 stops including depots and tram terminals. They are spaced according to the demand and population density. The distance between two following tram stops normally doesn't exceed the distance of 500 m, unless the urban situation requires it.

In Wrocław public transport it is not only tram network, it is also a bus net. There are about 260 buses which are running with the proper timetable through the whole city area. Buses run from 4 am to maximum 12 pm in working days. There are also in circulation night buses, which run from 12 pm to 4 am but their frequency is lower than the frequency of the daily ones. Normally during the day buses run each 15 to 30 minutes, what depends of the time of the day.

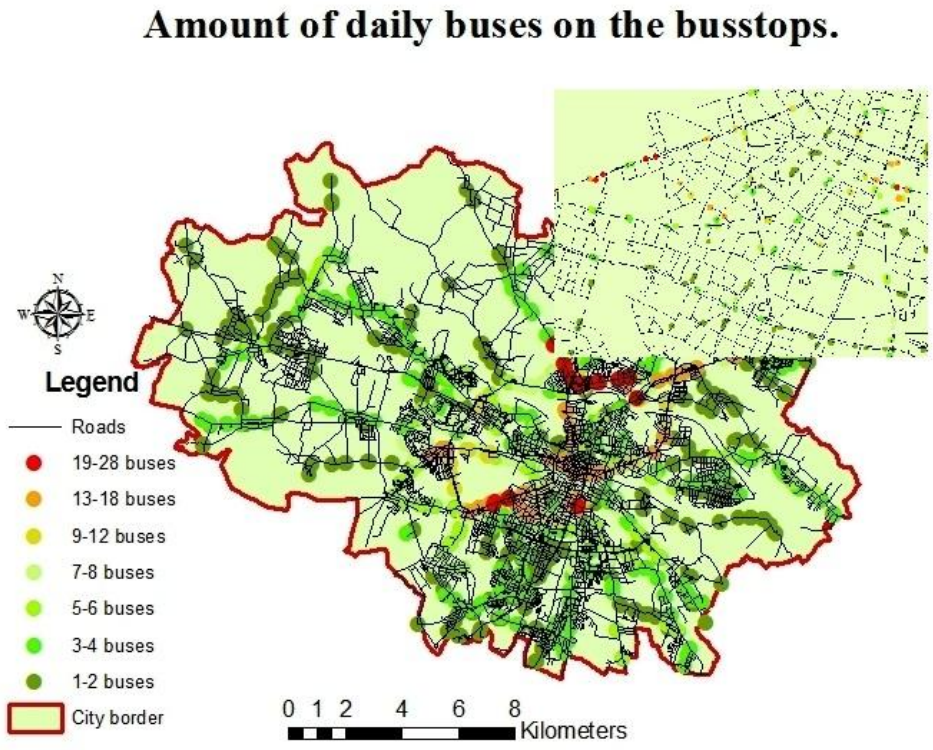


Fig. 3 *Amount of daily buses on the bus-stops*

The amount of buses on the bus-stops shows the differences between the city center and other districts of the city. The majority of bus lines intersect in the center within the lines of the main transportation routs. Daily buses cover the whole area of the city but their accessibility is not the same in each place.

Places where the biggest amount of buses is seen are mainly in direct neighborhood of tram stops, what creates the net of the tram and bus lines, intersecting and covering in many places for purpose of making urban movements easier and faster.

Notable is the amount and arrangement of night buses. Bus stops located near to the main railway station, Nadodrze railway station, and on the beginnings of the different direction routs are full of connections with the other parts of the city.But if somebody wants to move from one side of Wrocław to the other during the night needs at least one hour and sometimes few changes of the line. Each bus in the night is running with the frequency of 1bus to one direction for each hour. Main point, from where night busses start their routs is a railway station, and they starts with the frequency of half an hour, where one bus each half an hour goes in the direction invert to this one half hour later. In the other bus stops in the city normally there is no situation where one bus goes by one bus stop each 30 minutes. On the figure below it is shown that the location of bus stops and the number of buses is strictly connected to the density of the streets in the area of the city and because of that the population density[Fig. 4].

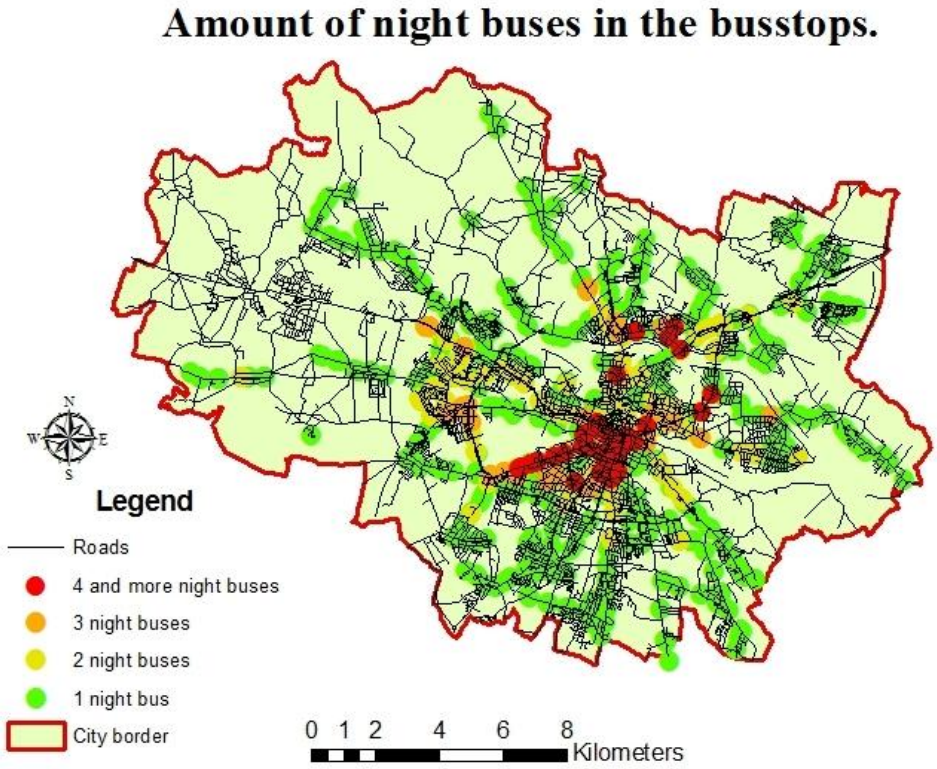


Fig. 4 *Amount of night buses on the bus-stops*

Talking about tram and their amounts on the tram stops doesn't show in a proper way the functionality of tram network. To present how many trams run on one rail, it was created the ribbon cartogram. Map presents the differences between the amount of tram lines on the one section of the rail. It shows where lines intersect, cover and what it goes behind it it shows the structure of the network. In the city center there is visible more intensity of tram lines. The situation is connected to the history of tram network development in Wrocław [Fig. 5].

The accessibility of the city was shown by usage of the buffer function. The buffer was created on the basis of calculating how far can one person go in 10 minutes. According to the average pedestrian speed which is about 6 km/h , in 10 minutes one person can come through 1 km, so one minute is 100 m of buffer on the map.[Fig. 6] and [Fig. 7] show the accessibility of means of transport in Wrocław. Maps show the distances from bus and tram stops. The area in both cases was divided by the buffer lines for zones. According to this zones we can notice that in the accessibility in Wrocław looks rather positive. In spite of the fact that there is a lack of tram routs covering the city, buses are spread around the whole city and fulfill lacks of tram network. The situation looks a little but different in the case of night buses, only main parts of Wrocław has a night communication on the level of a proper 2 buses/hour accessibility. Accessibility of night buses was calculated on the basis of the distance from the bus stop. If the bus stop was in the distance less than 500 m that meant the area of the city is accessible, and it is a worth place of living in.[Fig.8]

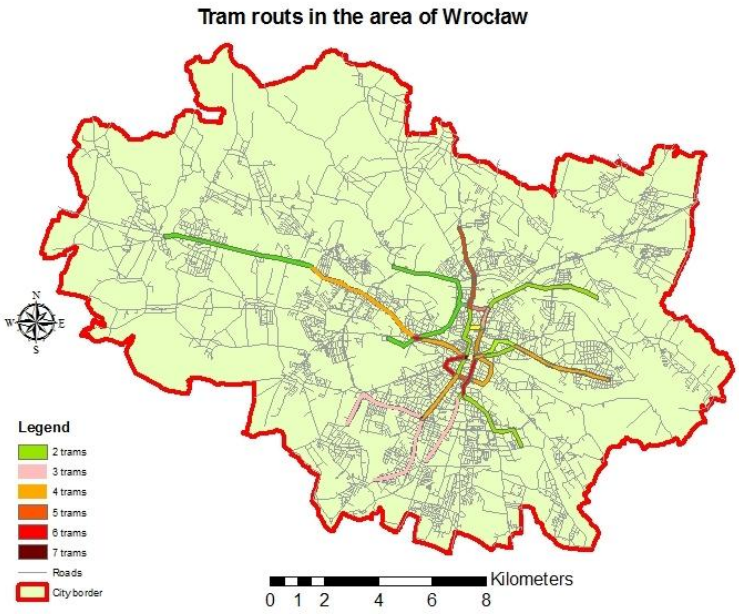


Fig. 5 *Intensity of tram routs in the area of Wrocław*

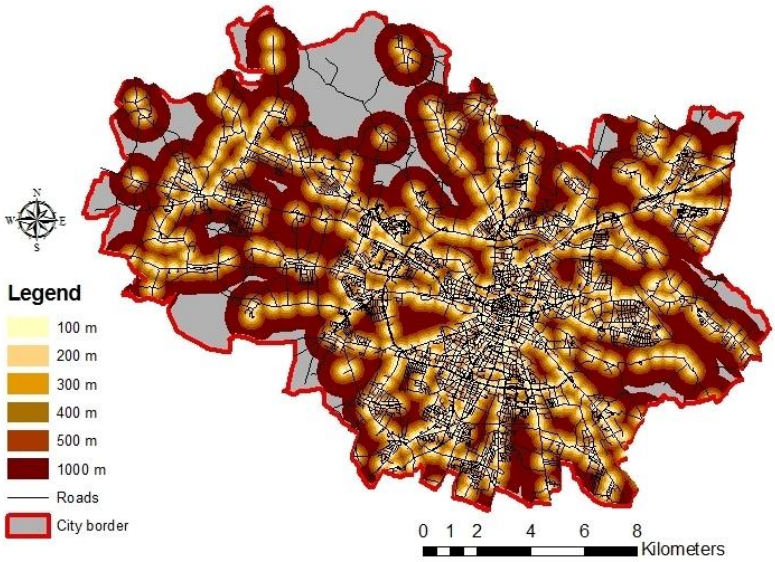


Fig. 6 *Accessibility – distances from bus and tram stops in the area of Wrocław*

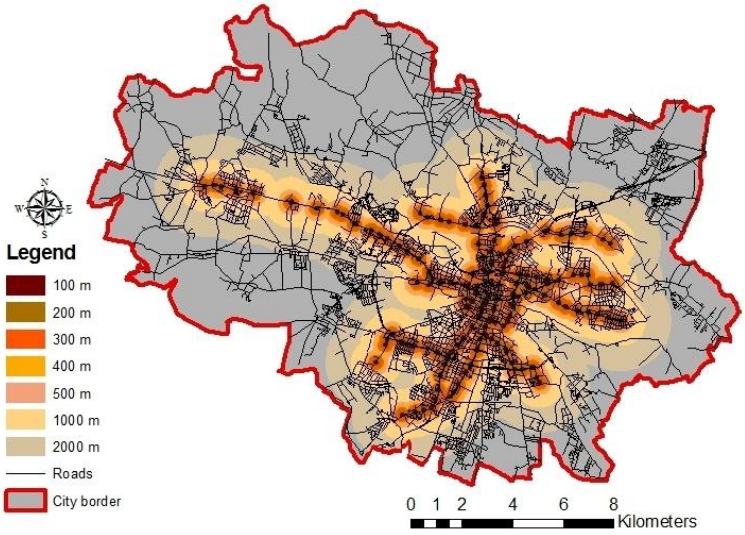


Fig. 7 Accessibility – distances from tram stops

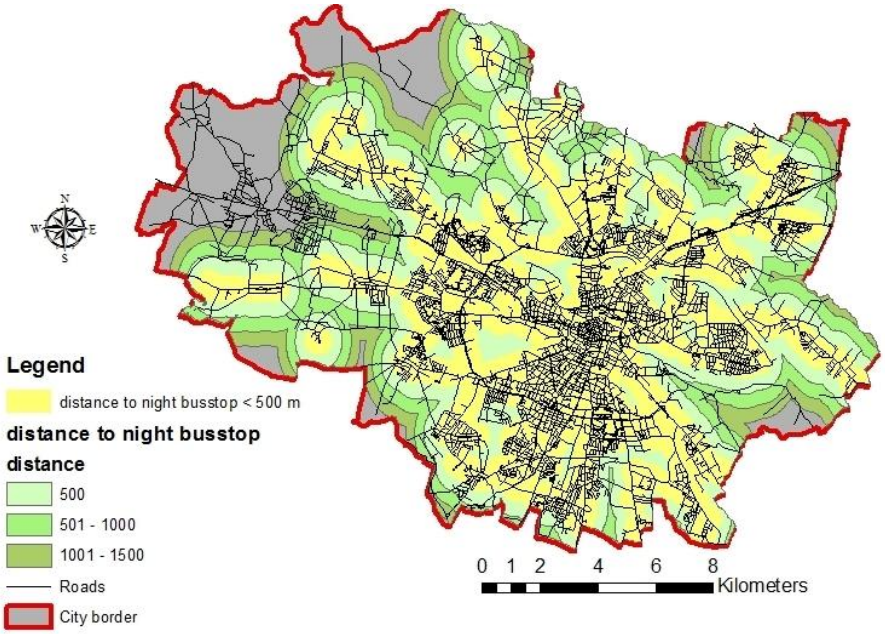


Fig. 9 *Accessibility of night buses in the area of Wrocław*

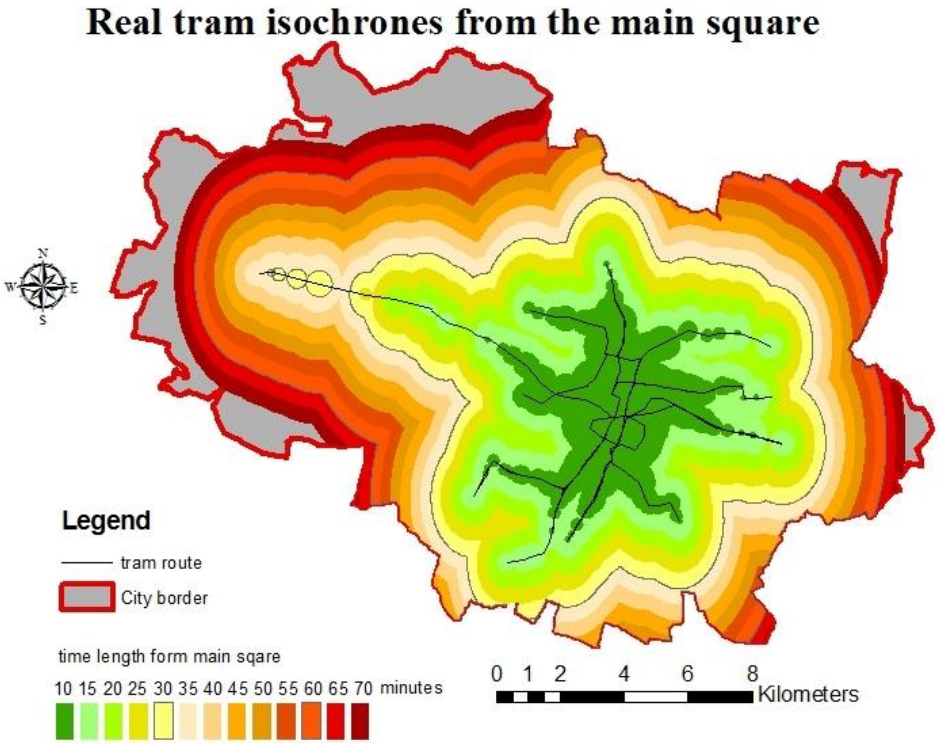


Fig. 9 *Real time isochrones from the main square in Wrocław*

The word isochrone is of Greek derivation (iso(s) – the same) and (chronos - time). It is a line on a chart or map connecting points of the same time. In competition analysis, the line connects points of equal travel time. An isochrone is easily distinguishable from a line connecting points of equal distance.[Fig.9]Real time isochrones were made for whole tram movements from main square .Isochrones show time in which passenger can reach places around the area of Wrocław. It is shown how long and how far the person can go by tram and then how long has to go by foot to reach the goal. Wrocław has a central communication network so in the city center person can easily reach everywhere within 10 minute, where the time distance of one minute of going by tram or walking correspondence to the distance of 100m on the map.

4 CONCLUSIONS

History of public transport shows, what changes have taken place on the breakthroughs of ages. With development of civilization, also changes took place in transport network. Human invents a newer method of transporting people or things and adjust network to new needs.

To learn about the history of public transport network I had to read many books, look at many old maps and analyze the various archival materials illustrating their course, and usage. In these studies using GIS obtained data can be cataloged and create from them the relevant databases, that next researchers will not have to browse the archive of hundreds of old and damaged materials. Using mobile technologies it's easy to obtain that database and perform analysis on them showing the changes that have taken over the many years in the public transport networks.

The modern world is a world of information, and in twenty-first century, GIS is a reality from which you cannot escape. It is the best tool for spatial analysis and visualization in the form of maps. Spatial data used to conduct the survey allow a thorough analysis of various phenomena that occur in the geographic space. Their record in the database for easy and quick analysis witch results can be placed in web sites, so that everyone can look at them. In an ongoing study using databases show that using GIS in transportation analysis is right and allows you to precisely analyze the situation in which there is discussed the transport network. Information on the location of bus stops, the number of buses, and each line allow the city to provide communication accessibility in the form of easily readable maps.

Descriptive analysis of data in case the transport network does not allow for clear understanding of the phenomenon, which is why you should always promote such research adequate visualization.

Analyzed information on the development of public transport networks in Wroclaw shows how hard times ware in the history of public transport network in the city, and network development reflects the situation in which at the present time the area was discussed.

Judging the accessibility maps of night communication possibilities it is concluded that approximately 70% of the city can move on a hourly intervals, but in the center of night buses are available at shorter intervals. Conducting spatial analysis of data transport networks transport gives excellent results and opens many opportunities for analysts and road or public transport investors. Adequate visualization of the urban transport network allows for an easy and rapid assessment of the situation on the roads, making it easier to get around the city, reducing the threat of accidents, or simply reducing the duration of the journey. Such analysis, if they are available on-line in real time for users, bring plenty of facilities in the methods of communication

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