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Public transport accessibility in Poznań

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1 ABSTRACT

Public transport played significant role in the modal split in Polish cities before the economic transition. Nevertheless, the development of public transport infrastructure could not keep up with the changes in urban structures. Since the beginning of the economic transition, cities have been trying to fulfil old gaps, but also to confront new problems (like increasing the motorization level, rising suburbanization, the lack of well thought urban development policy). Poznań is a special case study: on the one hand it has one of the best and innovative public transport systems, on the other hand car usage is on the highest level among the biggest Polish cities. According to the last general traffic surveys performed in 2,000, trips by car equalled 56%. It seems that the main reason of this situation is inappropriate development of the public transport network, which is not following by the urban development. Analyses were performed in 2009 by using advanced GIS and GPS tools. The paper presents the public transport accessibility level in Poznań in many aspects such as coverage of public transport stops and time needed to reach main destinations in the city. There were also examined extensions of routes between homes and stops according to the types of urban structures.

2 GENERAL VIEW

Poznań is one of the oldest cities in Poland. It is also Poland's fifth largest city (557,264 inhabitants in 2008) and fourth biggest industrial and academic centre (with more than 130,000 students). Poznań is the capital of the Wielkopolska (Greater Poland) Voivodeship. Since the 19th century the city has been one of the richest communes in Poland.

The spatial structure of Poznań was formed by: the Warta River, which is north-south axis of the city, two rings (one surrounding the downtown and one located approximately 6-7 km from the city centre) of former Prussian fortification and four triangles of the greenery (extending from the city centre to the city limits). The city structure is determined also by the network of main railroads (focusing in the main station – Dworzec Główny, which is located in the city centre). The city is comparatively flat. Until the end of communism the city was being concentrated relatively in small area, and the main idea of urban planning was the statement: “city of short ways”. Very visible were also triangles (wedges) of the greenery.

Since 1990 Poznań have been witnessing significant changes in urban development, living preferences and transport behaviours. The city has lost about 33,000 of inhabitants. In this time in the surrounding communes (Poznań County), the number of inhabitants has risen by more than 86,000 inhabitants. In effect, in 2008 Poznań County had 311,390 inhabitants. The migrations into surrounding communes (beside chaotic residential areas developed within the city limits) are creating many transport problems in the whole metropolitan area. In result the travel distances are lengthening and make inhabitants dependent on cars.

3 HISTORY OF PUBLIC TRANSPORT IN POZNAŃ

The development of public transport network does not following the spatial changes in the city. Inhabitants of new urban areas, customers of new shopping malls or workers of new industrial centres have to wait several months to get first bus connections to other areas of Poznań (in addition usually with low frequency). The development of tram network is much slower and new tram lines are not filling the network gaps which were appearing in the late 1970s and 1980s during construction of new residential areas.

Local authorities (in 80s) have been planning fast tram route in the north of the city to supplement the public transport network. The route (6.1 km) was opened after many years in 1997 and was a significant revolution for public transport in Poznań. It has allowed a rapid connection with the downtown for inhabitants of high-populated northern districts. The average speed of Poznań Fast Tram amounts to 35 km/h. However it has become a victim of its own success: the demand is higher than its capacity.

For the next tram-track inhabitants had to wait 10 years. In 2007 it was opened new track, which has a goal to optimize the network in city centre i.e. to shorten travel times and to give priorities in historical city centre

for trams. This investment can be also a symbol of changes in traffic policy concerning tramways: optimization of the network and priorities for trams in city centre instead of new tram-tracks to new housing estates. Outside the city centre, in narrow mining, the most important role is reserved for private cars.

4 PUBLIC TRANSPORT DEVELOPMENT PLANS

According to the general strategy for the city development from 1994, trams should be the fundamental mode of transport in the city. Since then, during renovations of the streets and traffic lights, it has been introduced some improvements in tram network, e.g. high priority at some intersections.

Currently in Poznań there are several plans to extend the tram network. Most of them are only conceptions. Only two of them have the chance to be constructed until 2013 (last year of financing investments from EU Structural Funds for 2007-2013):

- extension of route form Lecha terminus to the shopping centre M1 Franowo, with a depot at the end,
- extension of the Poznań Fast Tram route to train station Poznań Główny and connection with the rest of the tram network.

Only the first extension is sure because the old depot was sold in 2008 and city-owned Urban Transport Company has limited time to leave old one. The second conception is eagerly awaited by inhabitants expecting higher capacity of the Poznań Fast Tram, but this investment could be delayed till next years. In investments financed from EU Structural Funds for 2007-2013 there was also the extension of route through Zawady and Główna (northern-eastern part of city) to train station Poznań Wschód. However due to the economic crisis the city office decided to resign from it.

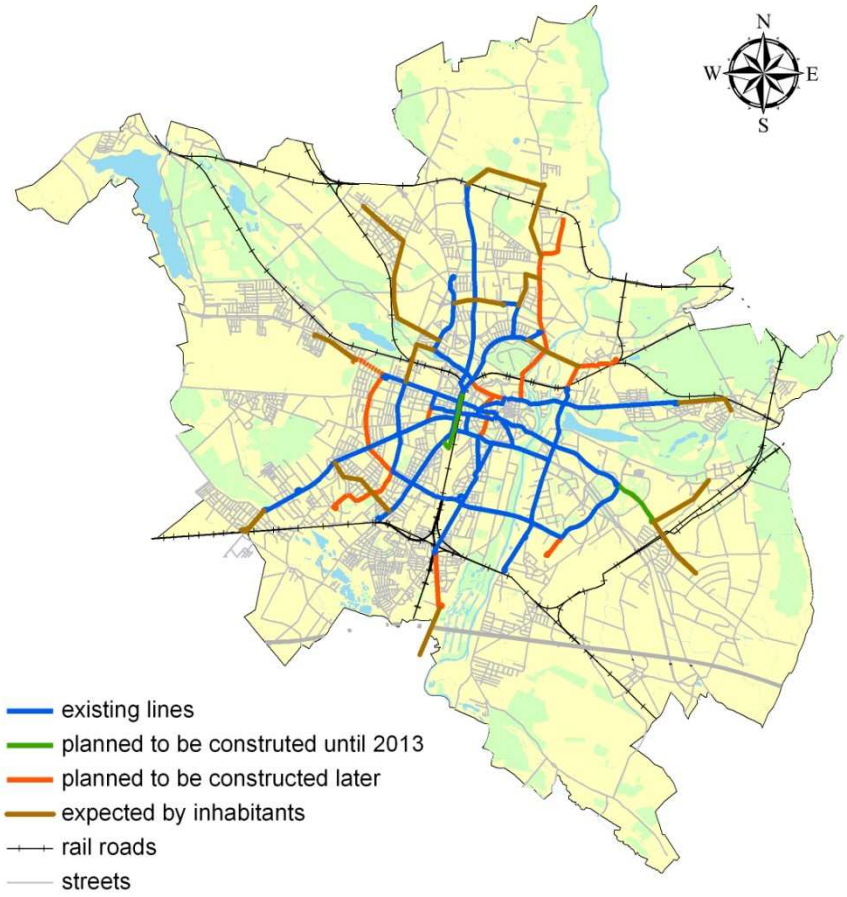

Fig. 1. Tramways in Poznań – existed and planned

Spatial development plans are more ambitious but they do not always meet the inhabitants' expectation – some important residential areas or travellers' destinations (e.g. Adam Mickiewicz University – campus Morasko) are still far away from tram network. Although the plans of tram network optimization have the biggest chance to be realized in the city centre.

Beside the plans described in investment plans or spatial development plans, there were several programs for tram-train system introduction and for rail tracks usage to connect metropolitan rail network and airport. These ideas do not have any chances for realization in the nearest future.

5 PUBLIC TRANSPORT NETWORK AND ORGANIZATION

Local public transport in Poznań is organized by Public Transport Authority and served by Urban Transport Company (MPK). Suburban, regional buses and local trains do not belong to public transport system of Poznań. During daily hours MPK is operating 19 tram and 54 bus lines and nightly – one tram line and 21 bus lines. Only one bus line is an express line and there is a necessity for passengers to pay an additional fee.

In 1993 in Poznań it was done a huge revolution in the system of tram lines. The number of lines was reduced from more than 20 up to 13. Simultaneously the frequency of the tram connections was improved. In result every weekday in rush hours (6:00-19:00) the trams are moving (with small exceptions) with 10 minutes frequency. On Saturday in rush hours they shuttle every 15 minutes and on Sundays and Saturday early mornings and evenings – every 20 minutes.

The bus lines are divided in three classes of frequency: main lines (15 lines), basic lines (11 lines) and supplement lines (26 lines). The main lines are coursing in peek hours (about 6:30 – 9:00 and 14:00 – 17:00) with a 12 minutes frequency and the basic lines – with a 15 minutes frequency. The supplement lines are coursing with different frequency: from every 8 minutes (for line connecting the Poznań Fast Tram with the university campus Morasko) till 60 minutes for some lines to suburbs within the city limits. During the summer vacation trams and buses have lower frequency (maximum: every quarter).

The length of the tram routes amounts to 66 km and of the bus routes – 318 km. The total length of the tram lines is 212 km and the bus lines – 573 km. The tariff system is based on short time tickets (for 15 min and 30 min) and long period tickets (mainly monthly tickets).

Poznań has the best buses and trams among Polish cities. Poznań was the first Polish city which decided to make a general modernization of its bus fleet. In 1996 first low-floor buses appeared on roads. They were bought in huge tender for 122 vehicles. In next years MPK or the city of Poznań were purchasing systematically new buses (usually several vehicles per year). Since 2004 monitoring has become a standard and since 2005 – an air condition. Present, the fleet consists of 310 buses (including 10 in leasing and 2 financed by one shopping mall) and 337 tram wagons (215 trains). Most of the buses are low floor vehicles but only 25 of trains have low floor. Next 45 low floor vehicles were ordered at the beginning of 2010. The average age of the tram fleet amounts to about 29 years but usually vehicles are well maintained. Modern fleet allows minimizing the troubles for passengers, e.g. delays, cancelled courses etc.

6 PROBLEM OF ACCESSIBILITY MEASURING

Accessibility of public transport system may be considered as one of the fundamental problems, which are faced by the modern city. This fact makes it necessary to develop appropriate mechanisms to assess its level. Often problems of accessibility and its level are not clearly understood – in literature could be found many different research methodologies. Litman (2008) presents some guidelines, which should characterize all the analyses on the accessibility of transport:

- Accessibility should generally be measured door-to-door, taking into account the travel links from origins to vehicles and from vehicles to destinations. For example, delays finding a parking space should be counted as part of travel time costs.
- Travel time costs values should reflect qualitative factors such as comfort and convenience. For example, unit time costs should increase with crowding and congested conditions.
- Travel distances should be measured based on actual network conditions, rather than as-the-crow-flies.
- Accessibility analysis should consider costs such as vehicle ownership and parking, not just vehicle operating costs.

According to these statements, researchers should take into account all aspects of travelling. It is necessary to concentrate investigations on comprehensive analyses which include all issues that could make public

transport more or less accessible. In result competitiveness between means of transport should be analyzed not only as the time-competitiveness.

In researches on public transport accessibility, it is also necessary to notice that each travel consists of a few stages, and each of them last a certain period. The total travel consists of sequentially:

- 1) coming to public transport stop,
- 2) waiting for the bus or tram arrival,
- 3) riding the public transport vehicle,
- 4) transfer operations, including:
  - a. move to stop to reach other line of public transport,
  - b. waiting for the bus or tram arrival,
- 5) passage of another means of public transport,
- 6) reaching the destination.

Attempts to shorten and facilitate all this stages are the necessity in modern and sustainable transport planning.

7 ACCESS TO PUBLIC TRANSPORT STOPS

In 2009 in Poznań there were made comprehensive and unique investigations on accessibility in public transport. At first ranges of the bus and tram stops were estimated. Acceptable distance to get them amounts to 300 meters for bus stops and 400 for tram stops (according to literature – Loose 2001), and this distance should be measured basing on actual network conditions, rather than "as-the-crow-flies" (Litman 2008, Tyler 2002). In Poznan this real distance is longer by 26% (it was measured by using GPS tools during the investigations).

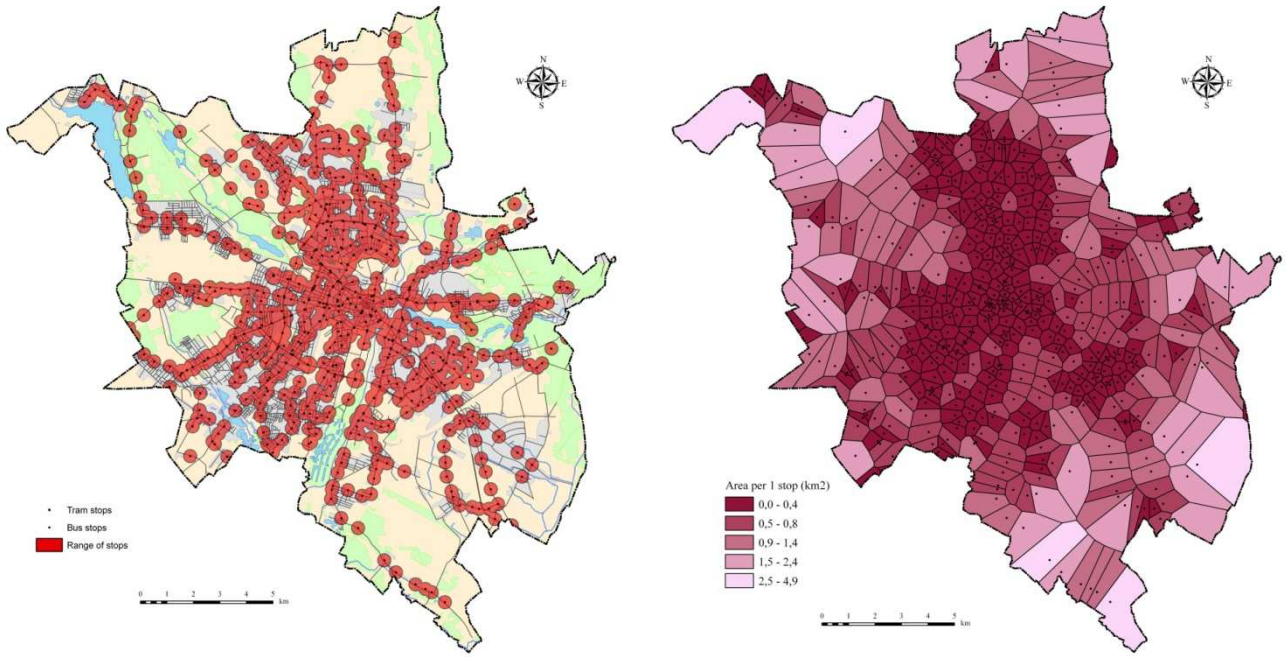

Fig. 2. Location (left) and density (right) of public transport stops

According to the study, 20% of Poznan's area is under the impact of public transport system. For built-up areas it is over 60%. The central area of the city is almost entirely covered by the bus and tram stops. But further away from the downtown, areas of coverage are losing their continuity. This situation reflects the rule that with growing distance from the city centre population density is decreasing and number of factories and commercial targets is going down. It could be also noticed that in many new settlement areas, public transport network is poorly developed. There are many "white spots" and in these locations a lot of people could have problems in reaching mass transport service.

One of advantages of public transport system in Poznań is the fact that the most of industrial and service areas are located in the sphere of stops influence. But still some services (the best example is one of district courts) could not be reached by tram or by bus. It is danger situation which could cause exclusion of some social groups with a low mobility (especially old and disabled people).

Overall it should be noted that development of public transport system in Poznań is not related with the growth of the urban space. Only in older city districts bus and tram stops were located in relatively rational and relevant distances. In areas of residential multi-family buildings it can be clearly seen that public transport lines do not cross this districts. Buses and trams are going only on the edges of such settlement areas. It is the result of old planning conditions, which was estimating acceptable path to stops to a distance of 500-1000 meters. Nowadays, when having a car is much easier, citizens of such districts often are choosing this mode of transportation. Cars are usually parked few meters from the block and it is much easier to reach them then to reach the bus or tram stop (Newman, Kenworthy 1999).

According to the principles of sustainable development policy in land use and transportation, very important case is locating new settlements areas along existing networks of public transport (especially tram-lines). On a smaller scale, it is very important to provide different facilities to promote walking and cycling. These solutions could help the city to overcome problems with crowded and noisy streets and to shorten times of travelling across the city.

Fig. 3. Tram line located on the edge of the biggest estate in Poznań (Photo: Jędrzej Gadziński)

8 ROLES OF TRANSFER STATION IN PUBLIC TRANSPORT ACCESSIBILITY

No direct connection between two stops cause that passengers have to travel by two or more public transport vehicles. The transfers between them are made on transfer stations – the places where at least two lines of public transport are crossing. Such a change in modes of transportation is always associated with a loss of time. It is caused by: possible walking to another bus or tram stop and waiting for the vehicle arrival. In order to minimize travel times, authorities, who are responsible for the city transport, should try to reduce the number of transfers - particularly between areas generating big traffic movements, as well as to facilitate moment of the transfer (Avishai, Marguier 1985, Larsen, Sunde 2008).

On the other hand, changing vehicles cause that the number of objects and areas, which can be achieved from the initial stop, significantly increase. Unreasonable and impossible it would be keeping the number of communication lines, which are connecting directly all areas of the city. Transfers are therefore a necessity and with appropriate planning they could be the great advantage of the communication network of the city and also could significantly improve its integrity (Brown, Hess, Shoup 2004).

Very important for passengers of public transport is the distance between the stop where they leave the vehicle, and the stop of the line, which they intend to continue their journey. No less significant are the barriers like communication traces with heavy traffic (especially roads). To increase the security of pedestrians, there are often crossings (which are often badly localized) and traffic lights. Another solution is building underpasses or overpasses over the streets. It provides to avoid collisions in the way to the bus or tram stop. However, usually that kind of solution is associated with the necessity to climb to the stairs or slopes or with waiting for the elevator (if installed) and often involves the elongation of the road, and the need of greater physical effort (Khisty 1994).

In the beginning of 2009 in Poznań, there were proceeded a detailed assessments of main transfer stations in the public transport network. It was selected 31 key points and all of them were connected by tram lines. During the study, it was measured the time needed to walk between all stops located on transfer station. There were also indentified the most important difficulties for travellers (especially for older or disabled people). The measurements were carried out during daylight hours at normal or increased traffic (from 800 to 1800)

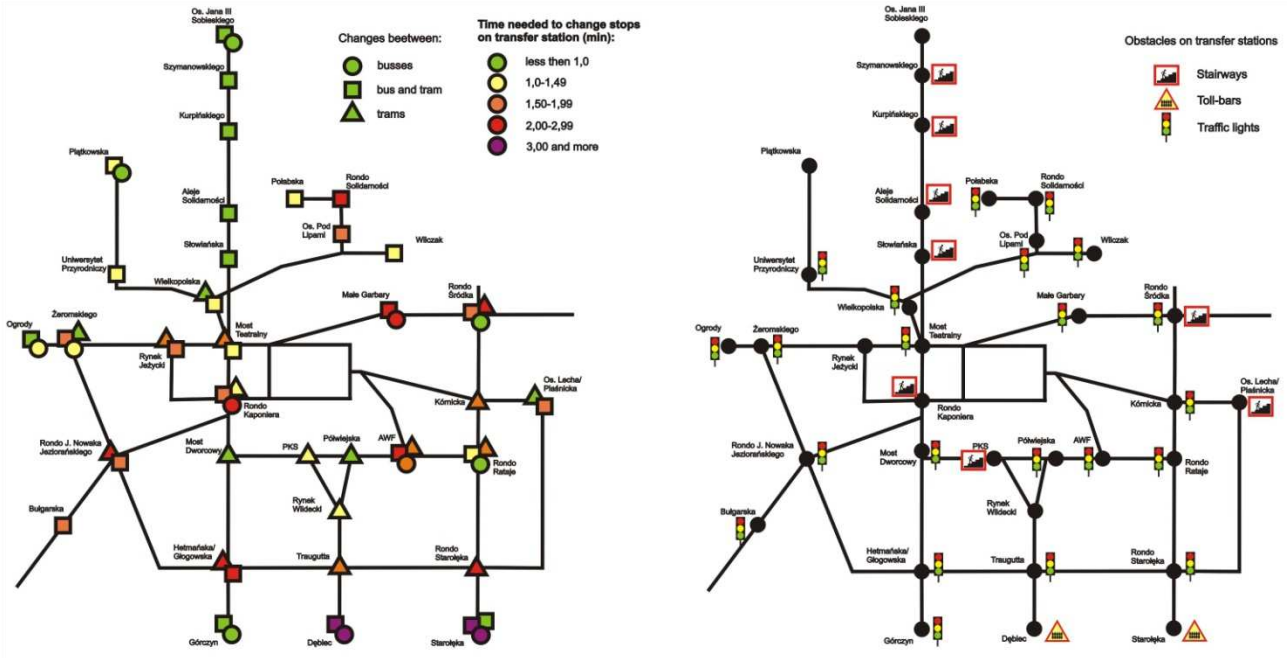

Fig. 4. Evaluation of the main transfer stations in Poznań: left: time needed to change; right: obstacles on transfer stations.

The above analyses shows that in most cases, the way between stops on transfer stations in Poznan is taking a long time. In addition, some transfer nodes are characterized by other serious difficulties that may exclude some groups of passengers with possibility to change the modes of transportation and in result to achieve the final destination. Time loss during the transfers should be significantly reduced through appropriate infrastructure improvements and investments in modern, integrated transfer stations. It is also necessary to make attention on the appropriate locations of new transfer stations. In the same time it should be implemented new projects, which include roads and railways passenger-friendly solutions.

In terms of architectural solutions very important problem is to supplement the existing underways and overways in elevators, which would allow access to persons in wheelchairs. Escalators also could be a good facilitate to improve the movement of disabled and weak people.

On the most transfer stations in Poznań the best solution to improve their integration is appropriate coordination of traffic lights. It should be given high priorities to pedestrians at intersections. Of course it would cause the deterioration of the conditions in cars movement at some points. But for cities, which want to implement rules of sustainable urban transport, such decisions are necessary.

Fig. 5. Lack of crossings to public transport stops causes dangerous situations on the street (Photo: Jędrzej Gadziński)

Another option, which might improve the accessibility of bus and tram stops, could be introduction of additional pedestrian crossings. Such solution would both: shorten the way to reach public transport stops, and improve traffic conditions at the bus stop. In many Polish cities very visible is the tendency to build the smallest platforms for passengers as possible. This bad practise could be also seen in many public transport stops in Poznan, even at some major transfer stations. The most vivid examples are Most Teatralny (Theatre's Bridge), Most Dworcowy and Polwiejska (all located in the city centre). A typical passenger reaction to that situation is crossing the road in forbidden places.

9 LEVEL OF TIME-ACCESSIBILITY IN PUBLIC TRANSPORT

Time-accessibility is one of the best factors, which can be used to estimate level of public transport services. According to this, it was made comprehensive analysis of time-accessibility for five important points located in Poznan's territory. First of them is Rondo Kaponiera – the main transfer station, which is critically important for public transport in the city. It is located in the central area of Poznań. Other points are situated on the outskirts of the city and are the objects, which are generating high traffic volumes. These facilities are: Ławica Airport (in the western part of the city), Adam Mickiewicz University Campus (on the northern outskirts of Poznań), the biggest cinema complex – Kinepolis (eastern part of the city) and shopping gallery – Panorama (south of the city). The selection of objects, allowed comparing the level of time-accessibility in different districts in Poznań.

The main purpose of the analysis was the identification of the major gaps in the bus and tram network, which could begin the discussions in Poznań about the competitiveness between public transport and other forms of movement: bicycles and cars.

According to the researches, the best time-accessibility was estimated for the central point – Rondo Kaponiera. This is mainly due to well developed bus and tram network, for which Rondo Kaponiera is the focal point. The most of tram lines (11 of 19) are crossing this transfer station. Other objects in comparison with the Rondo Kaponiera are poorly accessible. It is a negative phenomenon mainly due to the fact that they are one of the most popular destinations in the city. Many citizens are trying to get them every day, especially during rush hours, and they need and demand transport services on the high level. The average travel time to these objects (more than 40 minutes) makes the public transport loser in the competition with other transport modes.

One of aspects of suburbanization is shifts of public institutions, commercial centres and research units outside the downtown (Nijkamp, Pepping, Banister 1996). Poznan faces this process very deeply. Good examples are new buildings of Adam Mickiewicz University, which were located near the city borders. Also

some new hospitals, district courts and other public institutions are being moved from the city centre to the peripheral areas.

Dispersion of population and potential aims of travelling causes new problems in local transportation system. Direct travel connections between different suburban areas are getting more important. Deficiencies of transport infrastructure can already be seen today. For example between neighbouring districts – Podolany and Morasko – a trip by public transport takes over 45 minutes. To ride the same distance car needs only several and bike nearly 20 minutes.

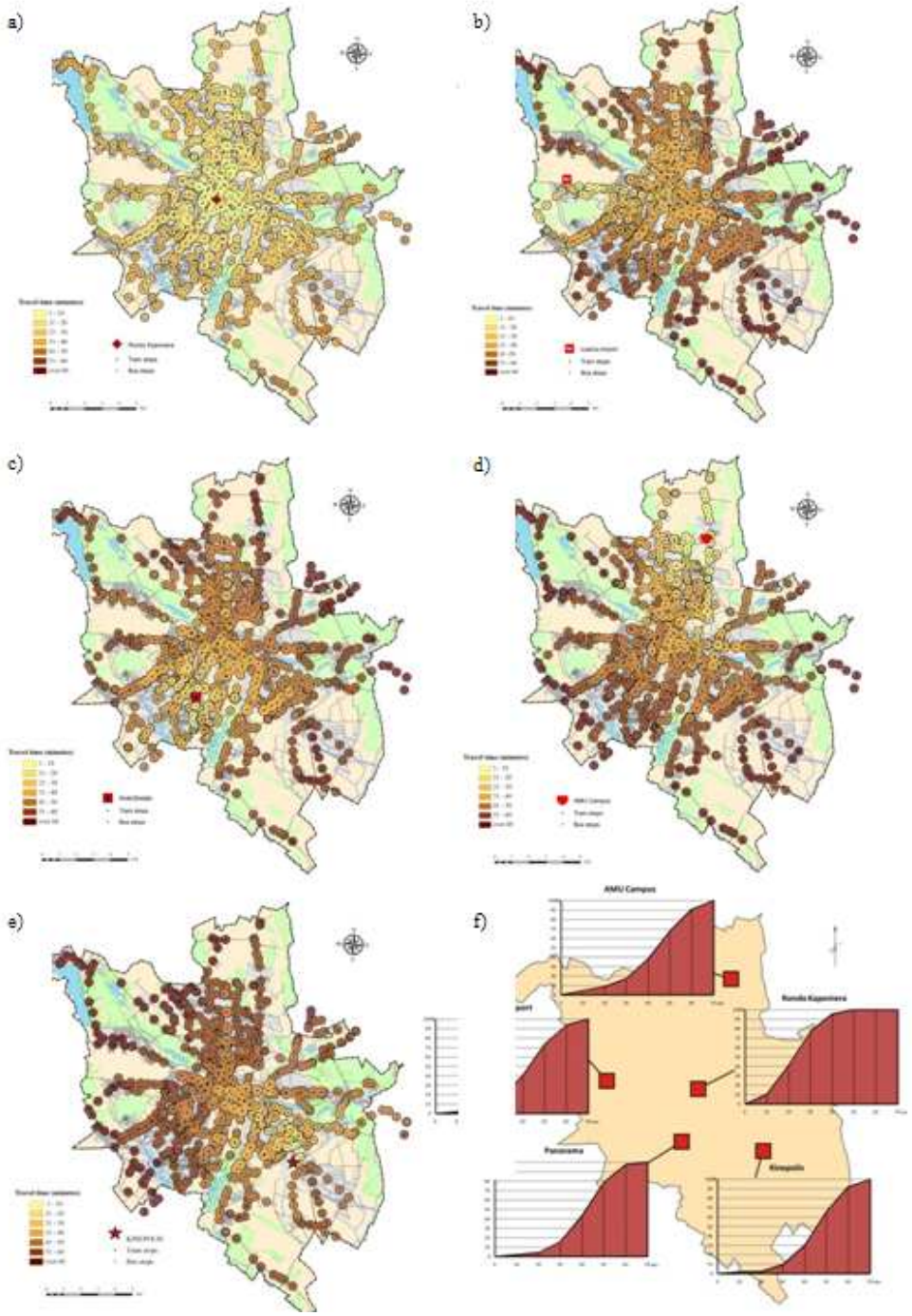

Fig. 6. Public transport in Poznań – time-accessibility level of the main travellers' destinations. : a) Rondo Kaponiera, b) airport Ławica, c) Panorama - shopping mall, d) campus of Adam Mickiewicz University (Geosciences faculty), e) leisure centre Kinepolis; f) comparison of accessibility to these destinations.

At the same time, under the influence of changes in the economy (growing importance of services sector), communication behaviours of inhabitants are changing. People are travelling more and more in many directions. In the same time, the importance of existing transport lines is declining – mainly these lines are ensuring only access from residence areas to major production facilities. Together with suburbanisation

process, it leads to the further dispersion of citizen's travel directions. The result is new challenges for public transport system in the city (Banister 2001).

10 CONCLUSIONS

Poznań's experiences show that the modern solutions in economy and policy do not guarantee sustainable transport. Although MPK has one of the best fleet in Poland, every year local public transport is losing passengers. Main reason is car oriented transport policy and the lack of integrated urban and transport planning. The special importance has suburbanization process. While public transport is following new investments within city limits with huge delay, outside the city many new districts have not any connections or there are only a few per day. Development of road network is a strong competitor to public transport. New roads paradoxically are deepening transportation problems.

The isochronal analysis shows that there is a big lack of radial tram lines establishing rapid connection between districts (especially in northern part of the city) and there is also a need to extend tram network to new settlements and to the most important destinations of the daily trips. Small improvements like priorities at the intersections with intelligent traffic lights or the optimization of tram network in the city centre are not sufficient to make public transport winner in the competition with private cars and – in many cases – with cycles.

11 POSSIBILITIES FOR TIME-ACCESSIBILITY IMPROVEMENT

Ensuring good time-accessibility in the local public transport in Poznań is strongly difficult. The city growth seems to be chaotic due to relatively liberal urban planning law. Often new settlements are appearing far away from existed tram network and new bus connections have been establishing after several months, (sometimes up to 2-3 years) since the settlement has been constructed. Additionally the local transport policy put more stress on road construction than tram network development.

The most important method to improve the time-accessibility is construction of ring tram tracks establishing direct connections between neighbouring districts. Only southern part of the city has tram track connecting big settlements without transit through the city centre. Northern part of tram network is star-shaped pattern. All trips to northern districts have to be done through one, overcrowded tram intersection (Most Teatralny). This solution lengthens travel time significantly but also enlarges the risk of delays caused by broken vehicles, impropriate work of intelligent traffic lights, problems with switches etc. The ring lines of buses are not an interesting alternative. Most of them have low frequency and small average speed because of traffic jams. Moreover, the public transport authority treats these lines usually as "social lines" which should bring children to schools, elderly people to shops etc. The routes are sometimes enormous lengthened to the way which can be done by car. These bus lines should be redefined and partly changed for rapid transit between main districts as long as new ring tram track will be built. The second task to improve Poznań's public transport is developing tram network and extending it to the biggest settlements and the most important destinations (e.g. AMU campus, airport Ławica). These extensions usually meet the inhabitants' expectations presented on fig. 1.

Administrative decisions or low cost investments could also be a chance to shorten travel time. Creation of new bus lines, construction of common bus and tram routes, priorities at intersections and etc. can improve the traffic flow of busses and trams. Nevertheless it is solution mostly for the city centre and does not answer to main problems on peripheries.

Some potential is hidden in regional rail. Recently regional trains have mostly low frequency and relatively small average speed. They are not integrated in Poznań's fare system. Furthermore, the location of train stops is usually away from new settlements or industrial areas.

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