

Urban Railway within the Linear Urban Structure: the Case Study of Perm, Russia

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1 ABSTRACT

Perm is a city of slightly under one million inhabitants situated on the banks of the Kama River, in the European part of Russia. Being the 4th largest city in Russia in its area and only 13th in terms of population Perm stretches for over 80 kilometres along the river. Largely due to the city's linearly extended urban structure a significant part of its population experience serious commuting problems. Most of the remote areas of the city are not well integrated into its central part and suffer from poor connectivity and accessibility. The latter is the feature shared by many other cities and other post-Soviet states, so the experience of Perm may also be instructive and useful to other cities.

When it comes to improving the connectivity between different areas of the city, metro railway is one of the commonly used type of contemporary urban interventions. In 2004 the project "Urban Train" was launched in Perm with an ambitious aspiration to become "a "skeleton of the city transport system". The new route was set up using the existing railway lines. It has a total length of 51 km and includes 22 stations on both sides of the Kama River. All other modes of transport, namely buses, trams and trolleybuses, were to be connected with this newly established route. The project was funded by the regional budget.

Despite the fact that Urban train has obviously failed to become city's principal mode it did provided several remote areas of the city with comparatively fast and convenient way to get to the city centre. In the years 2004-2008 the number of passengers was stable at around 1 mln people annually but starting from 2009, when several trains were removed from the timetable, the number of passengers dropped significantly every year reaching around 0,6 mln in 2013. After that the question of the abolition of funding for the project was raised. The service is still in place but the question of financing remains open. Nevertheless, the company managing the project has plans of further infrastructure investment.

The paper analyses the ten years' experience of Perm to develop its system of the urban train trying to reveal the reasons for its modest performance and decline in the passenger traffic. The authors show how the Urban Train fits within the city urban structure and evaluate the potential of the Urban Train to become a feasible solution to the problem of connecting the periphery with the city centre. Furthermore, the paper tries to answer the question whether the proposed further development of the project, including the formation of the transport hubs, is worth implementing in terms of increasing efficiency and volume of passenger traffic. Finally, the authors make some general conclusions on the feasibility of projects of this type in the context characteristic of post-socialist cities in Russia and beyond.

2 INTRODUCTION

Like many other Russian cities, Perm - a city of slightly under one million inhabitants in the European part of Russia - suffers from sprawl, inadequate transportation system and consequent mobility problems.

Urban mobility is one of the most critical issues for all post-socialist cities. Current mess is the result of the lack of effective planning and short-sighted and uncoordinated policies on land use and transportation. Starting from the 1960s many socialist cities adopted the pattern of massive residential development at the periphery of cities resulted in longer commuting distances (Becker et al, 2012). The problem was further exaggerated during the transition period characterized by suburbanization of housing, retail, and jobs. At the same time, the system of public transport was completely devastated during the 1990s and was not longer able to cope with this growing demand (Engel, 2007). While the socialist cities generally possessed highly developed and efficient public transport network, the transition period was characterised by the heavy reliance on the private automobile and the fact that public transportation system was largely neglected and underfinanced.

The majority of public policies adopted during the transition period have been aimed at accommodating the growing number of automobiles at the expense of undermining all other modes of transportation. Thus, most of the public financing for improvements in the transportation system has been directed to expanding the

vehicle carrying capacity of streets by adding new traffic lanes and building multi-level intersections, with the main purpose of moving more cars faster. Such policies have achieved little but induce more automobile use, thereby considerably aggravating the existing traffic and transport problems, and eroding the quality of public space (Stanilov, 2007). The poor coordination between development plans and urban transportation systems has led to chaotic and inefficient traffic patterns, which have generated bottlenecks in the existing street network.

In Russian cities these negative trends still persists today (Vuchic, 2011). Dispersed urban structure coupled with an ill- conceived approach to transport planning cause serious mobility problems. The city of Perm shares the problems of other post-socialist cities but also has its own specific features aggravating the situation.

3 CASE STUDY

Since the date of Perm's foundation in 1723 as a settlement attached to a copper-smelting plant, the nature and pattern of its urban growth was largely linear. Urban forms of linear character are the result of settlement's development along either natural boundaries or artificial boundaries such as transportation routes. In case of Perm the river set the direction of development and served as the city's structural axis:

Today Perm stretches for over 80 kilometres along the Kama river. It is the 4th largest city in Russia in its area (almost 800 sq.km) being only 13th in terms of population. The area of the city is unreasonably big with low average density (Appenzeller and Gietema, 2010). In accordance with the recommendations of national planning rules Perm with its current population should occupy a built-up area of only 56 sq. km, the existing buildings occupy only about 118 sq. km - seven times less than its current area (Generalnyi Plan Permi, 2010). This is the result of the city's extensive growth during the Soviet period. A number of surrounding villages were included in the territory of Perm in 1920s and later in 1938. Such settlements as Zakamsk, Kuria, Gaiva, Levshino and others became the city's new remote areas while the space between them and the old centre remained vacant and often not exploited. Transport links between them remained poor (in some cases one still has to pass through the city centre in order get from one remote area to another).

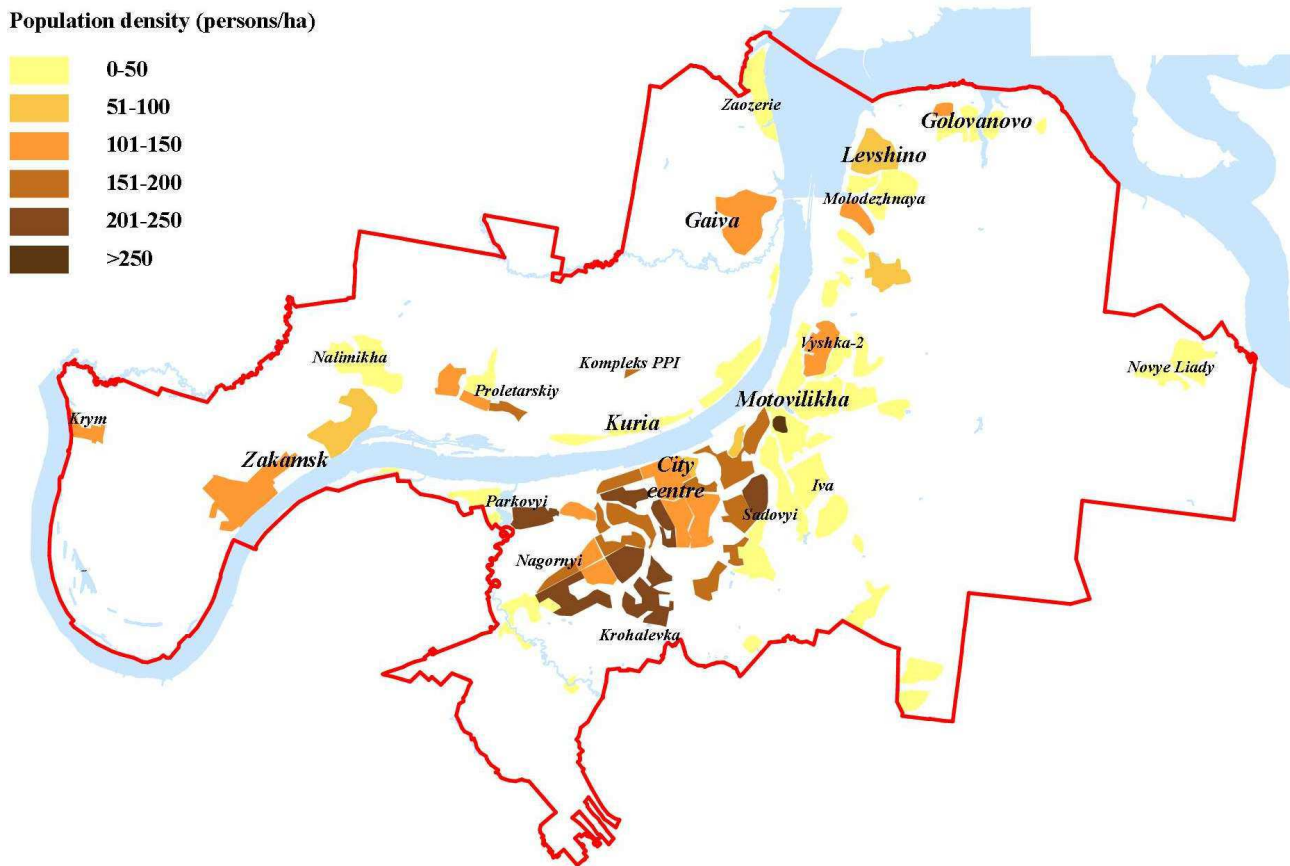


Fig. 1: Distribution of population across the city. Adapted from Generalnyi Plan Permi, 2010

Spatial structure and urban form of the city greatly affects the operation of its transportation system. The following are the problems characteristic of the cities with the linear urban structure and the dispersed low-density development:

- Increased length of transport communications;
- Increased level of transport dependency;
- Relatively low efficiency together with the high cost of public transport;
- Intense transport use leading to the negative environmental impacts.

Thus, transportation problems shared by most post-socialist cities, in Perm are worsened by the its historically formed linear shape. Largely due to the Perm's linearly extended urban structure a significant part of its population experience serious commuting problems. Such remote areas of the city as Zakamsk, Gaiva, Kuria, Levshino, Golovanovo and others are not well integrated into its central part and suffer from poor connectivity and accessibility.

4 URBAN RAIL TRANSIT FOR PERM: A PANACEA?

When it comes to improving the connectivity between different areas of the city, urban railway is one of the commonly used types of contemporary urban interventions.

Starting from 1970s many cities around the world have introduced different rail transit systems and the most popular one is Light Rail Transit (Topp, 1999). LRT along with tramway and metro belongs to a rail transit family of transport modes providing fast and convenient service to large masses of people. Being a high capacity transport mode LRT at the same time requires much lower investment cost than underground metro (Vuchic, 2002). Depending on the city's structure and its transportation system LRT may function as a suburban feeder to metro or serve as the principal transport mode. In any case rail modes of transport are in most cases superior to motor transport in terms of stability, speed, comfort and environmental impact (Morozov, 2010).

In Russia there are no systems that fully comply with the concept of LRT in the conventional sense. To date seven Russian cities have underground metro systems, and most major cities have one or another kind of electric rail transport, be it a tram, commuter rail, or light metro. There are also dozens of unrealised projects, some of which date back to the Soviet era.

The idea of introducing some kind of rapid railway system in Perm also has a long-standing tradition. Soviet norms required that any city of 1 million people be equipped with metro. The first official project of Perm metro was published in 1982. However, construction has not begun due to the financial constraints. Since then Perm authorities have come back to this issue repeatedly. The in-depth analysis of the feasibility of the project was performed in the Integrated Transport Scheme of Perm (KTS, 2008) commissioned by the Department of Planning and Development of Perm. At that time the transportation planners have concluded that the efficiency of metro in Perm will be very low due to "the lack of sufficient volume of passenger traffic concentrated in one direction" (Petrovich, 2010). In the KTS (2008) it was proposed to make greater use of intracity sections of the Trans-Siberian railway and the further development of the existing tram network.

Being one of the hubs of the Trans-Siberian railway Perm has more than 100 km of railway lines. In 2004 the authorities of Perm region seeking to improve the connectivity between different areas of the city decided to employ the existing infrastructure to launch the new project named "Perm Urban Train". The new route was set up using the existing railway lines including intracity sections of the Trans-Siberian railway. It had a total length of 51 km and included 8 stations and 14 stopping points on both sides of the Kama River (Fig 2): Golovanovo, Bannaya Gora, Levshino, KamGES, Molodezhnaya, Kislotnyi, Balmoshnaya, Ubileynaya, Yazovaya, Motovilikha, Slavyanova, Perm I, Dzerzhinskaya, Perm II, Perm-Sortirovochnaya, Komsomolskaya, Zheleznodorozhnaya, PromUchastok, Kuria, and three stations outside the city - Las'va, Mysy, Overyata.

The Perm Urban Train project was the first attempt to develop LRT-like system in Perm. As stated in the project's official description (PPK, 2013) the project pursued the following goals:

- Provision of the higher level of service at the rates equal to the rates of alternative modes of public transport (mostly buses) within the city limits;
- Increase in the number of passengers transported by rail and subsequent road transport load reduction in the same direction;
- Improving the environmental situation by reducing the number of bus routes;
- Ensuring the timely delivery of workers to the industrial sites with introducing the train timetable linked to work shifts schedule;

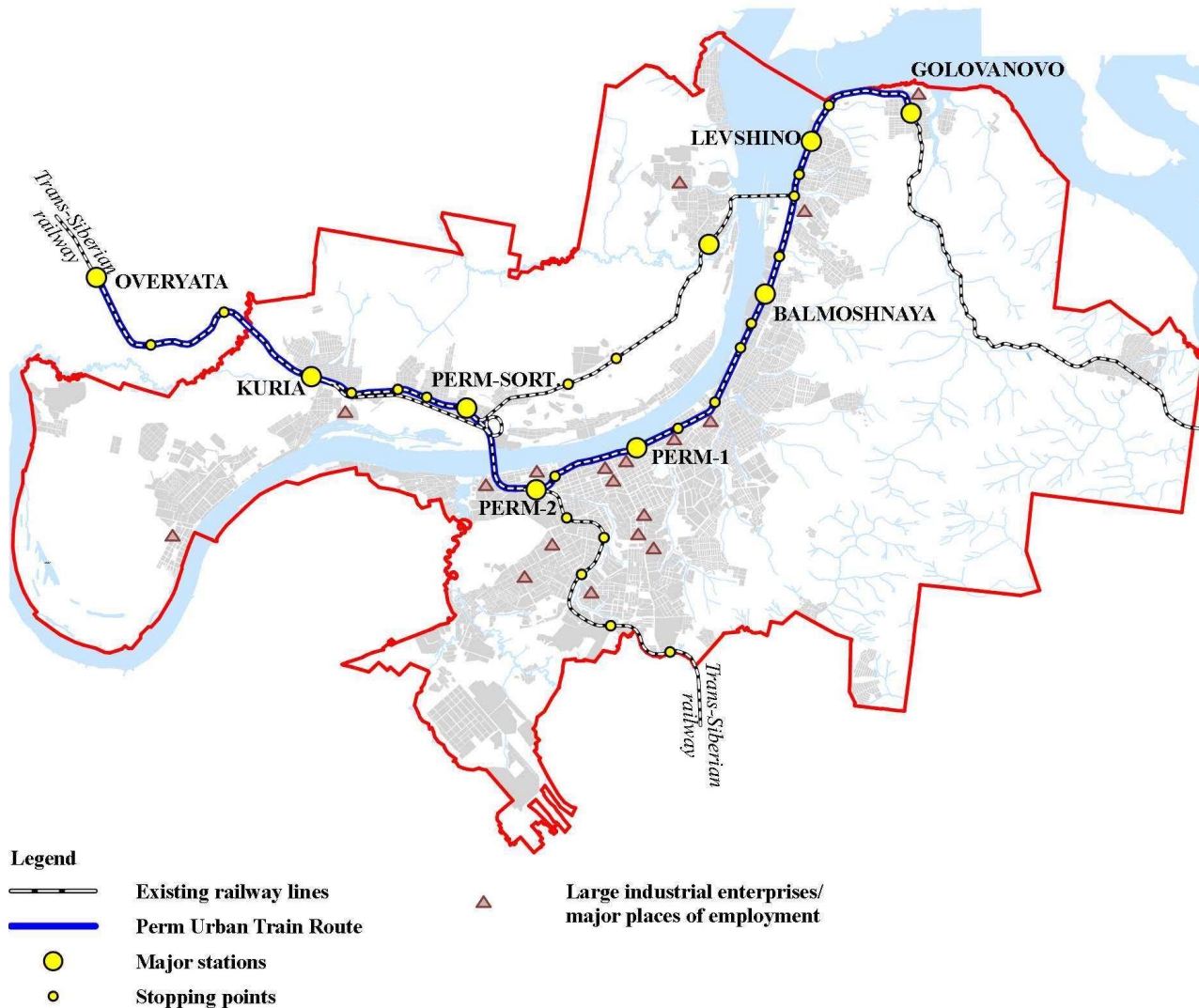


Fig. 2: Railway network of Perm and the Perm Urban Train route

Among the remote areas served by the Urban Railway are Golovanovo, Levshino, Molodezhnaya, Motovilikha and others, with the total population of 16,5 thousand people within the radius of pedestrian accessibility from stations. Large industrial enterprises such as LLC "Galogen", the Kirov Plant, the Dzerzhinsky engineering plant and others fall within the coverage area of the Urban Train. Hence the Urban train can serve as a 'suburban feeder' to the transit network of the city formed by trams as it was recommended in the KTS (2008).

And, indeed, according to the official documents (PPK, 2014) the project was started with an ambitious aspiration to become a "skeleton of the city transport system". All other modes of transport, namely buses, trams and trolleybuses, were to be connected with this newly established route. The Urban Train was to become Perm's version of LRT resolving the mobility problems without much effort and investment on the part of the city.

Thus, at the moment of its launch the project has presented a quite feasible solution to the problem of connecting the periphery with the city centre and seemed like a perfect fit to the city's linear urban structure. If implemented properly it could potentially become the basic network for the city's new more comfortable and efficient transportation system.

5 2004-2014

A decade has passed since the project launch and it is possible to draw some conclusions.

The total number of passengers of the Perm Urban Train from 2004 to 2013 amounted to more than 8 million passengers. In the years 2004-2008 the number of passengers was stable at around 1 mln people annually but starting from 2009, when several trains were removed from the timetable, the number of passengers dropped significantly every year reaching around 0,6 mln in 2013.

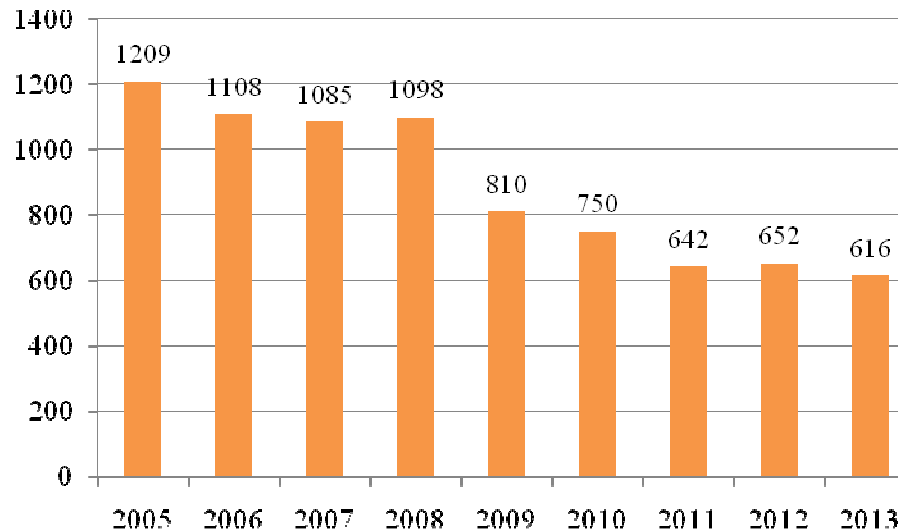


Fig. 3: The number of passengers of the Perm Urban Train from 2004 to 2013, thousand people. Source: PPK, 2013

Apart from the Perm Urban Train there are also several regional trains, which pass the same route "Golovanovo - Overyata". However, in 2010 the share of passengers who chose rail transport to get to the city centre in the morning rush hour was only about 12%. And only 2 % of all commuters used the Perm Urban Train (Generalnyi Plan Permi, 2010). Trains also run half-empty during the day: according to the annual report for 2013 (PPK, 2013a) the average carriage occupancy rate was 22 out of 110 seats.

Despite the fact that the Urban Train has obviously failed to become city's principal mode it did provide several remote areas of the city with comparatively fast and convenient way to get to the city centre. Perm Urban Train is the fastest means of public transport to the city centre from many areas. For example, it takes 38 minutes to get to the terminal station Golovanovo by train while the same trip by bus may last between 60 and 120 minutes depending on the time of the day. The table of comparison between travel times to some other stations by train and by bus is presented below.

Points of departure and arrival	Travel time by bus, min	Travel time by train, min	Reduction
Perm I - Golovanovo	90	38	58%
Perm II - Levshino	60	39	35%
Kuria - Perm II	90	23	74%

Table 1 Comparison of travel times by bus and by train. Source: personal observations

If this train does provide faster access to the city centre and backwards, what are the reasons for its low popularity and the constant decline in the passenger traffic? The reduction in the number of passengers is due to the fact that a significant portion of them opt for alternative modes of public transport. The preferences of passengers were determined by the following factors:

- cancellation of a number of trains and simultaneous increase in the number of bus services, taxis, parallel to the route of the Perm Urban Train: there were 32 trains per day when the project was launched in 2004 and only 9 trains per day were running by the end of 2014 ;
- poor accessibility resulting in long travel times to the railway stations;
- high non-competitive price: by the end of 2014 the cost of the journey (regardless of the distance) was 21 roubles, while the trip by bus cost only 13 roubles;
- poor quality of station infrastructure.

The factor having the greatest influence on the popularity of the Perm Urban Train is its irregular timetable. There is no regular interval timetable and there can be gaps up to 2-4 hours outside the rush hours. Yet the need to increase the number of trains and to reduce the intervals of their movement is an issue that cannot be easily resolved. The factors impeding the solution of this problem will be mentioned in the next section.



Fig. 4: Perm II and Golovanovo stations

6 PROPOSED INFRASTRUCTURE DEVELOPMENTS

Several propositions aimed at increasing the efficiency of the Urban Train were made in the Perm Strategic Masterplan (2010) and the General Plan of Perm (Generalnyi Plan Permi, 2010). Some of them included both physical improvements of the current infrastructure and its further development.

Looking for the ways to make the train intervals competitive with buses the authors of the General plan emphasize two main factors impeding this: 1. an insufficient capacity of rolling stock and 2. an insufficient capacity of railway lines in some sections. According to the General Plan the left bank section of the Perm Urban Train line (Perm II-Golovanovo) has an excess capacity and the main problem with the capacity of the railway network is related to the Trans-Siberian Railway. The latter is already running at its capacity while the two-track railway bridge over the Kama creates a real bottleneck.

The solution presented in the General Plan is to build a by-pass track to the south of the city. The proposed track would remove the burden of immense freight traffic from the Trans-sib section going right through the city centre. However, the construction of the by-pass demands such amount of investment that is not currently available to the city. Increase in the number of trains will also require considerable investment.

Proposals for the development of rail transport include the reconstruction of seven stations on the line Golovanovo - Perm II: Perm II, Perm I, Motovilikha, Ubileynaya, Molodezhnaya, Levshino, Golovanovo and two completely new stations. The reconstruction project of Perm II implies turning it into a major travel hub with redevelopment of adjacent area and reorganization of transport and pedestrian links with the city centre.

Although the current infrastructure leaves much to be desired, this issue cannot be considered as a priority. According to passenger survey held in 2013 the renovation of stations' and stopping points' infrastructure is only 5th in the list of improvements needed (UralINSO, 2013).

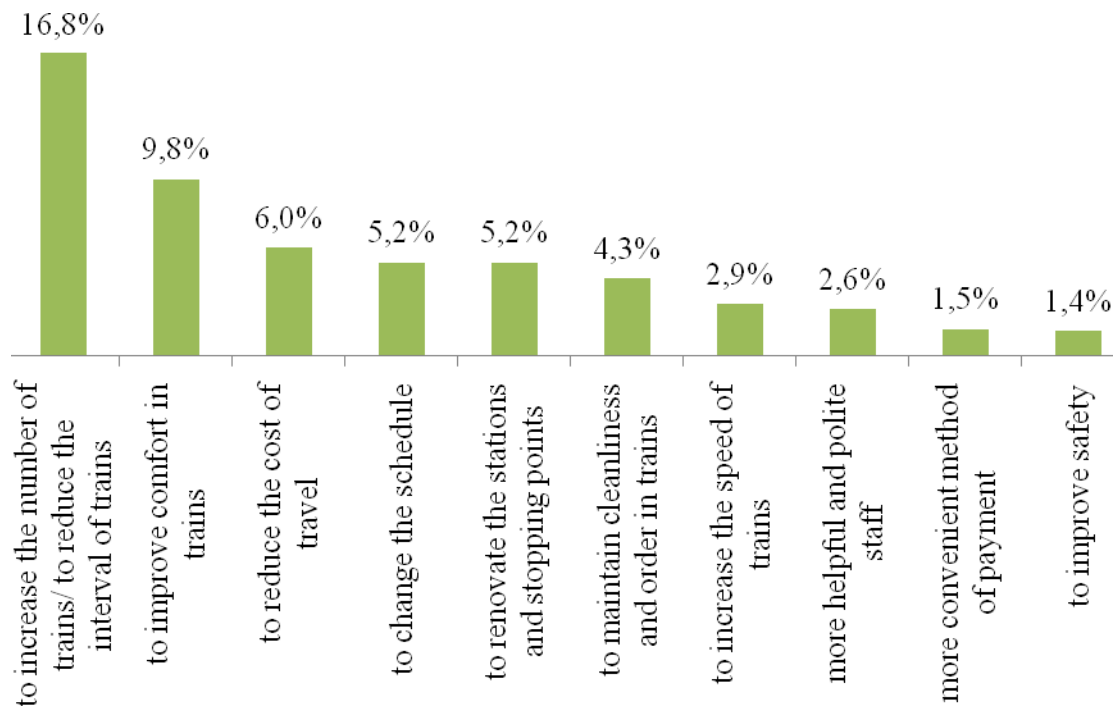


Fig. 5: Suggestions for improving passenger rail transport. Adapted from UralINSO, 2013

As far as the proposed extension of the route along the right bank of the river with two additional stations Kabel'naya (existing) and Gaiva (planned), this proposition seems to be reasonable in terms of increasing efficiency and volume of passenger traffic. Two stations may generate almost 13 thousand more passengers daily in addition to 16,5 thousand living in the area of pedestrian accessibility of existing stations (Generalnyi Plan Permi, 2010).

Further development is also proposed by the Perm Suburban Company that runs the Perm Urban Train project (PPK, 2013). Their plan is to connect stations on both sides of the river into a circular route (using existing rail lines) with movement organised both clockwise and counter-clockwise. Although the proposal seems promising in terms of expanding the area and correspondingly the proportion of the population served by the Urban Train, it is not clear what source of funding the Perm Suburban Company was intended to use for such a large-scale development.

Apart from the big infrastructure developments there are ways to increase the effectiveness of the existing system of rail transit in Perm which does not require as much capital investment but strong political will and organisational reforms.

7 POSSIBLE ORGANIZATIONAL IMPROVEMENTS

To cover the operating costs of the route it is necessary to increase the number of potential passengers. The following reforms are suggested in order to improve the service and to encourage rail transit ridership:

1. Reducing the intervals of the train, as already mentioned, is the most needed step towards attracting more passengers since the inconvenience of the current schedule for many passengers outweigh all the advantages of the Urban Train over alternative means of transport. This may be achieved either by rearrangement of the existing fleet, e.g. splitting longer trains into two on the routes running with intervals, or by investment into new rolling stock, thus improving both the intervals and the level of comfort.

2. Improved coordination among modes and integration of the Urban Train into the city's public transport system is a foreground transformation that may be beneficial not only for rail transport system, but also for the city's public transport network as a whole.

This can be achieved in several ways. The first and most obvious step is to introduce a single (and simple-to-use/understand) ticketing system compatible with other modes of public transport. Such systems are in place in most cities with developed public transit since the mid 2000s.

Better modal integration on stations and stopping points is also a very important step towards attracting the new passengers. Possible developments in this field include turning at least the major stations into proper transportation hubs with exchange opportunities from train to buses, trams and other modes of transport with simultaneous harmonization of their schedules. Other ways of modal integration include:

- Arrangement of near-station parking lots allowing car users to leave their vehicles safely and change to train;
- Organisation of short bus routes between places of residence and train stations as a feeder service to the Urban Train;
- Improving pedestrian accessibility and approaches to the stations and stopping points.

3. Finally, it is important to make the use of the Urban Train clearer and easier. Improved availability of passenger information combined with various marketing programs aimed at popularisation of the Urban Train and rail public transit in general will make a significant contribution to the development of the project. One petty nuisance inherited from the Soviet times, which may be easily disposed, is that railway schedules are published in Moscow time (time difference 2 hours).

However, the implementation of the above innovations requires monitoring by a locally based transport company capable to coordinate the full range of issues related to the functioning of the urban transport system. The fragmentation of urban administration, which is evident both in post-socialist and developing countries, hampers the success of policy planning and implementation. Many authors call for organisational change and for better co-ordination of structural units of administration having urban transport responsibility as a crucial element of efficient performance of city's transportation system (Cervero, 1998; Dimitriou, 1990; Stanilov, 2007).

8 PROPOSED ADMINISTRATIVE REFORM

Today the Perm Urban Train project is run by the Perm Suburban Company, which is a subsidiary of Russian Railways (51 percent owned by Russian Railways and 49 percent by Perm region). Around 58 percent of operating costs are covered by transportation fees, the rest is subsidised by the regional budget. In 2014 the regional government raised the question of the abolition of funding for the project since it was not ready to subsidise intra-urban public transport. The city budget also does not have the necessary funds. The service is still in place but the question of financing remains open.

Meanwhile, the problem is not unique for Perm. Many other Russian regions have similar Suburban companies operating commuter rail transportation. During their creation in the early 2000s the rolling stock was not included in their authorized capital. As a result the rental payment for the carriages and locomotives accounts for almost 70% of their operating costs. This rental payment and the tariff for the use of railway infrastructure are charged in favour of Russian Railways. Many regions consider the pricing policy of Russian Railways as opaque and refuse to subsidise the Suburban companies (Terentyeva, 2015). This issue, however, lies beyond the scope of the current study.

Coming back to the question of the management of urban transport systems. Today regional and municipal carriers (urban train, trams, trolleybuses) are put in conditions of uncontrolled competition with private carriers (buses) that offer services of low quality often delivered by obsolete fleets but at affordable rates. Such a policy not only adversely affects the performance of the Urban Train and electric transport operated

by the city but inevitably leads to the overall ridership losses and forces passengers to switch to private automobiles. In order to facilitate integration of all modes of transport in one efficient system an intermodal transportation company may be established in cooperation with the Government of the Perm region. This will increase the level of coordination and co-operation between all public transport providers and allow to put into action integrated ticketing and tariff system controlled by the city.

9 CONCLUSIONS

To sum up, it may be argued that at the time of its establishment the Urban Train Project presented an innovative but ready-to-use solution to the Perm's issue of low connectivity raised from its historically fragmented urban fabric.

Taking into account the linear urban structure of Perm and the existing railway lines along its structural axis, some semblance of Light Rail Transit embodied in the Perm Urban Train appeared to be an obvious solution. And indeed rail systems successfully function as primary connecting mode in linear cities and agglomerations in Russia and beyond, i.e. Volgograd Metrotram, Russia or SKM in Tricity of Gdansk, Gdynia and Sopot, Poland.

However, the project has not received due attention from the regional authorities who initiated the project nor it has attracted enough support from the authorities of the city. The Perm Urban Train was not integrated into the city's network of public transport leading to the competition with other modes and the gradual loss of passenger volume.

Planning and developing of effective transport system requires an integrated approach based on the best practices in transport planning but also concerning city's specific features. Among the developments and the reforms described above the creation of the intermodal transportation company or the local government body managing the whole transport system seems to be a most urgently needed one. In Perm as well as in all other Russian cities it is necessary to ensure a higher level of coordination between the different modes of transport and facilitate mixed-mode commuting.

Apart from those already mentioned one of the feasible perspectives of mode integration in Perm is the formation of the tram-train system. The basis for such system will be the left bank section of the railway and the well-developed tram network in the south part of the city. As for infrastructure developments the most important and cost-effective proposals include the redevelopment of the Perm II station, the addition of two new stations Kabel'naya and Gaiva, the construction of intermodal node Levshino. The possible developments of secondary importance may include creating several other intermodal nodes of varying significance and extension of the route in two directions: 1) to Zakamsk with the construction of new railway lines (around 8 km); 2) to Ferma using the existing lines (see Figure 6).

The development of the efficient transportation system with the rail transit as a backbone presupposes the abandonment of the current overreliance on private automobile transport and adopting a new systematic approach to transportation planning. Overcoming chaotic and inefficient traffic patterns characteristic of most Russian cities requires sufficient political will and civic drive to give the priority to more sustainable modes such as rail transit and to allocate needed resources. Subsidies in the system of public transport should be evaluated against the costs associated with road traffic: capital investment into road construction, the cost of road maintenance, road safety, organization and construction of parking spaces and so on. The investment into urban rail systems in the long term may be the most cost-effective solution improving mobility at a lower total cost, including costs to government, consumers losing time in traffic jams and the city's environment.

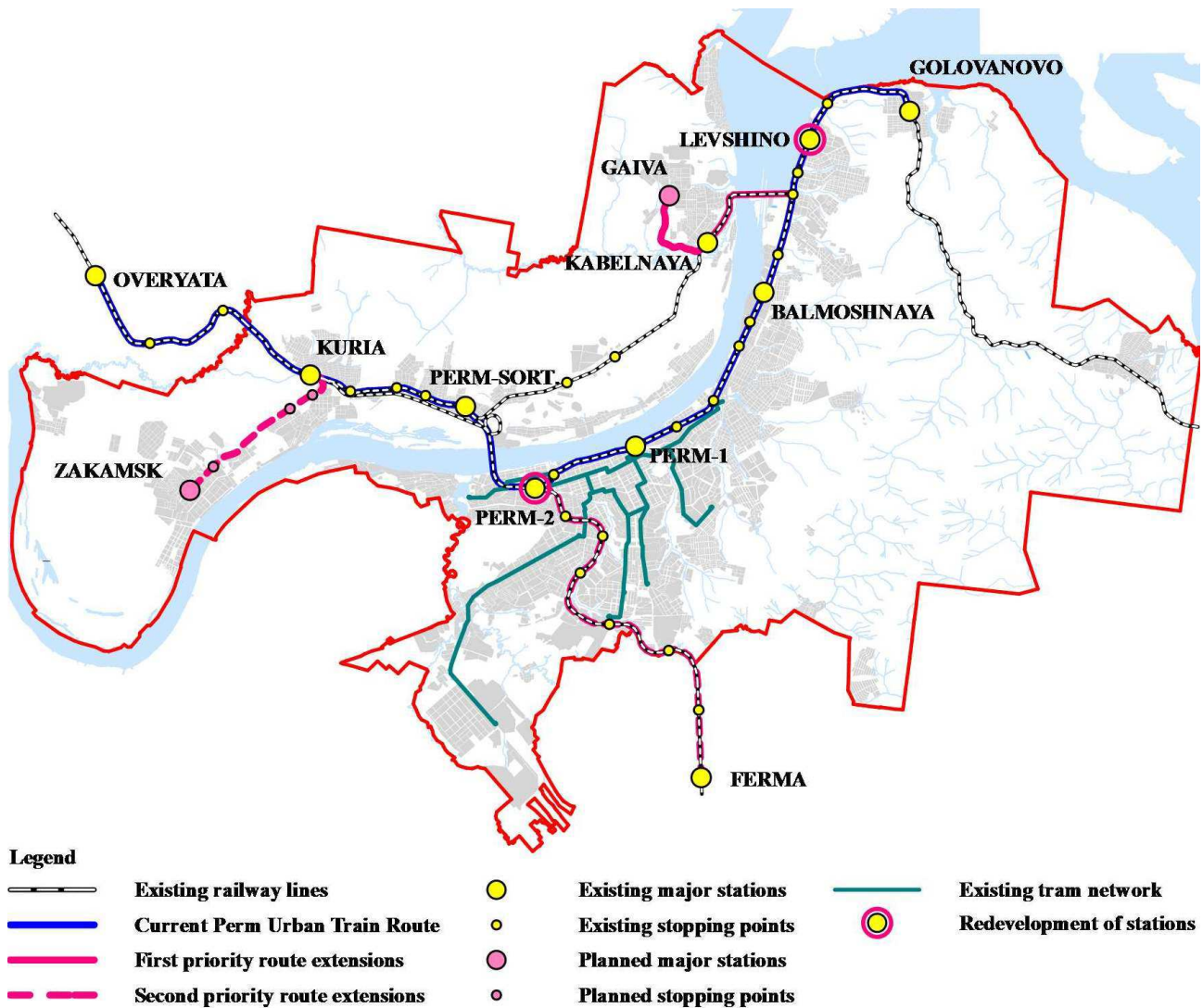


Fig. 6: The proposed development of rail transit in Perm

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