DOI 10.22394/1726-1139-2018-9-79-93

Mobility as a Life Quality Domain

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ABSTRACT

The land areas covered by cities are growing rapidly in size in the 21st century, and huge urban agglomerations and megalopolises are becoming highly interconnected. Their functioning is impossible without rapid transportation modes providing the possibility to populations to move easily in the daily rhythms of life and commuting. This mobility has become an established "way of life," growing hand in hand with increasing urbanism in the 20th century. As a consequence, mobility is now one of the most important subjects of research in a number of scientific disciplines.

This article analyzes different approaches to the theoretical research of mobility systems and assesses their practical effectiveness and efficiency. The approaches are evaluated as possible development ideas for the very unstable and underdeveloped mobility system in St. Petersburg, the second-largest city in Russia. Among other data, use is made of analytical reports and documents from Russian research centers and the municipal authorities of St. Petersburg.

The main research approach employs an analysis of comparative mobility systems, and it evaluates mobility as a crucial city life domain based on a mobility model developed by the author.

The research results illustrate the character of the global mobility problem and the full inclusion of Russian cities into the modern context. They also provide a detailed picture of aspects of the problem which are relevant for St. Petersburg. The conclusion presents multiple ideas about the development rationality of city mobility systems: rail and computer controlled electric cars as possible solutions.

Keywords: global urbanization, agglomeration, megalopolis, transportation, mobility, commuting, a new way of life

Мобильность как определяющий фактор качества жизни

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РЕФЕРАТ

В XXI веке площади, охватываемых городами, быстро увеличиваются в размерах, а огромные городские агломерации и мегаполисы становятся тесно взаимосвязанными. Их функционирование невозможно без быстрых видов транспорта, позволяющих населению легко передвигаться в повседневном ритме жизни и ездить на работу. Эта мобильность стала установившимся образом жизни, растущим рука об руку с ростом урбанизма в XX веке. Как следствие, мобильность в настоящее время является одним из важнейших предметов исследований в ряде научных дисциплин.

В данной статье анализируются различные подходы к теоретическому исследованию систем мобильности и оценка их практической эффективности. Подходы оцениваются как возможные идеи развития крайне нестабильной и слаборазвитой системы мобильности в Санкт-Петербурге, втором по величине городе России. Среди прочих данных используются аналитические отчеты и документы российских научных центров и муниципальных органов власти Санкт-Петербурга.

Основной подход исследования основан на анализе систем сравнительной мобильности и оценке мобильности как важнейшей сферы жизнедеятельности города на основе разработанной автором модели.

Результаты исследования иллюстрируют характер проблемы глобальной мобильности и полного включения российских городов в современный контекст. Они также

дают подробную картину актуальных для Санкт-Петербурга аспектов проблемы. В заключении представлены многочисленные представления о рациональности развития систем городской мобильности: железнодорожных и управляемых компьютером электромобилей как возможных решений.

Ключевые слова: глобальная урбанизация, агломерация, мегаполис, транспорт, мобильность, коммутирующие перевозки, новый образ жизни

1. Introduction. Recent decades have seen a particular interest in the mobility problem in large cities. These cities' huge dimensions cause various accessibility hindrances to citizens, hindrances which are very difficult to overcome. People who spend three or four hours a day on the way to their workplaces and home again become tired and unhealthy, and they have little free time left for the self-development and life-long learning required to live satisfying lives in a modern society. Given the large amount of time spent commuting, they cannot be happy in their families and micro-societies. Mobility and the accessibility of goods, services, and locations of work, learning, and leisure are an integral part of life quality and are understood as necessary conditions of mankind's progress.

A considerable number of research articles and monographs are devoted to the quality of life (QOL) problem, its different aspects and characteristics. Researchers have attempted to move from an elusive and poorly defined concept to more definite theoretical models. One of these efforts was made by the Australian scientist Robert A. Cummins [3]. According to his model, different life domains can be analyzed from the objective (objective QOL) and subjective (subjective QOL) points of view and integrated into a homeostasis which defines the overall subjective well-being of people in a particular location. All variables in the model depend on such categories as development level, usage of new technologies and communication modes, and private and public resources; and the model requires not only in-depth life quality analyses but also the help of quantitative research. This research trend is connected with the cost-benefit analyses also used in political decision-making processes, and currently it is included into a broader scale of economic mobility evaluation [25]. Mobility and accessibility as interconnected problems are discussion objects at international meetings[1], with most world countries participating because of the growing importance and acuteness of their cities' problems.

Russian cities are now searching for their own mobility system models to improve the accessibility of goods and services for all citizens. The core problem involves the mobility of particular social groups (pensioners, people with low incomes, low mobility groups, schoolchildren and third-level students) who cannot afford to buy a car and need public mass transport services to guarantee accessibility to the bare necessities of life, such as labor, education, and healthcare, but also leisure and entertainment. The Soviet mobility model did not include the idea of mobility freedom, with the latter's notion of the possibility for an individual to choose the most convenient mode of mobility. However, freedom is also always connected with responsibility and creates chaos[2]. We can now see the results of irresponsible development in our cities: the number of cars is growing exponentially, the speed of vehicles is decreasing, accidents are increasing, and mobil-

[1] One of the most representative meetings is the International Transport Forum. In 2017 it was devoted to the issue of "Governance of Transport". URL: https://2017.itf-oecd.org/ [15] [last accessed 12 March 2018]

[2] It should be understood that chaos is not a form of destruction; it is an aspect of diversity's highest level and presents the possibility for a system to develop to another configuration. This means that freedom creates chaos and, at the same time, a possibility for further development. However, it is a complicated task to develop a roadmap for transforming this possibility into a real improvement of the system. See: [20]

ity costs are rising. Citizens' level of satisfaction is declining. In this article an attempt is made to show possible ways to master the growing crisis.

2. Materials and methods. On the basis of Cummins' overall QOL model, a special mobility model is constructed and describes mobility parameters using the categories of objective and subjective QOL.

The new mobility culture in Russia analyzed by V. Popov [19] is a relatively recent social phenomenon, and it is difficult to find data for an analysis for Russian cities. This article takes as its analysis subject the second-largest city in Russia, St. Petersburg. Statistical mobility data for St. Petersburg[1] are compared with those of Moscow[2], since the majority of conditions in the two cities are similar. To these data are added data from several cities in other countries, because analyses of comparative foreign experience can help to highlight the peculiarities of mobility in Russia. Many of the materials used for theoretical and empirical studies are findings from international organizations and scientific discussions. These materials show the global nature of the mobility problem and mobility's interconnection with accessibility to goods and services in the broadest sense as a *sine qua non* for man's self-realization and the further development of mankind. In this article's research, the data and conclusions of the Sustainable Cities Mobility Index 2017 [22] are used. These are the main partial indicators which together build an overall mobility indicator. Into the Index are included 100 cities from all parts of the world. The only Russian city listed in the Index is Moscow, and the goal of this research is to evaluate St Petersburg's mobility system in comparison with that of Moscow. This provides the possibility to evaluate the overall mobility in St. Petersburg according to three indicators, which together comprise the Mobility Index: *People*, *Planet*, and *Profit*.

Based on more than 20 indicators, the Sustainable Cities Mobility Index evaluates the quality of overall mobility. Briefly, the sub-index *People* (social and human implications of mobility systems) show the mobility system features connected with people's safety and their need for different mobility modes. This sub-index is based on a city's performance in a framework of the following indicators: fatalities, access to transport services, modal split of journeys taken, rider connectivity, upkeep of the metro system, wheelchair access and uptake of active commuting, transport applications and digital capabilities, airport passengers, and hours of metro accessibility. The sub-index *Planet* (environmental impacts — energy, pollution, and emission) includes various impacts of the mobility system on the ecological characteristics of a city: transport greenhouse gas emission, provision of green space, congestion and delays, bicycle infrastructure, air pollution, efforts to lower transport emissions, and electric vehicle incentives. The sub-index *Profit* (efficiency and reliability of a mobility system to facilitate economic growth) evaluates the economic features of mobility systems and consists of such indicators as commuting travel time, economic opportunity (the share of revenues in the transport companies expenses), public finance, efficiency of road networks (maximum speed limit), affordability of public transport (transport spending as a percentage of income), and utilization of the transport system (average number of public transport journeys per capita).

The theoretical background from the economic and social point of view is based on materials from the International Mobility Forum Round Table report "Quantifying the Socio-Economic Benefits of Transport" [16] and the Corporate Partnership Report "Linking People and Places Together. New Ways of Understanding the Spatial Access in Cities" [15].

Cities without cars [9; 18] are difficult to imagine at this time; nevertheless, this tendency is already visible in many world cities with exclusively pedestrian areas, part-and-

[1] URL: http://gov.spb.ru/gov/otrasl/c_transport/statistic/ ; http://gov.spb.ru/gov/otrasl/blago/ [both last accessed 12 March 2018].

[2] URL: https://www.mos.ru/upload/documents/files/peerreview_moscow_report_russian.pdf [last accessed 12 March 2018]; http://strelka.com/ru/magazine/2015/12/28/itogi-2015-veloactivis.

ride systems, and city rail systems, and in our study an attempt is made to discover some features of this tendency in St. Petersburg.

The mobility problem is also an object of public interest. Documents and informational materials of St. Petersburg's citizens' organization "St. Petersburgers for Public Mass Transport"[1] and of the scientific and planning workshop "Laboratory for Urban Planning" are therefore used in the article for statistical data verification and evaluation of citizens' satisfaction levels [2].

3. Results. The model of Cummins [3, p. 704] provides an opportunity to construct a mobility model for a city, showing this life domain as a very important feature of life quality in large cities and agglomerations.

The objective variable is the mass transit services. The first analysis level yields relatively positive results for St. Petersburg: since 1955, the city has a metro system in operation, and this has grown over time to currently consist of 67 metro stations. There are also a large number of bus routes, tram routes, and trolley-bus routes. While an overall comparison of these numbers with the quantitative indicators of Moscow's mass public transport shows differences[2], we must remember that Moscow's surface area is now 2600 km^2, while St. Petersburg is much smaller: 1,439 km^2.[3] This means that the second-largest Russian city is about half the size of the largest one, and the St. Petersburg mobility system corresponds with the dimensions of the city under Russian conditions and is not less developed than in Moscow.

No less important is the subjective side of the model. In both cities, the perceived deficit in mass transit services is large, but the deficit in St. Petersburg is considerably worse than it is in Moscow. This is a consequence first of all of the city's lower metro development level. For more than 3 million citizens of St. Petersburg, the nearest metro station is more than 1 km from their living place. The traveling speed of trams, buses, and trolley-buses is becoming increasingly slower, and there are long delays in traffic, which makes journeys much longer. People get anxious, tired, and aggressive. The "gaps" in the mobility system are filled by route taxis, and this leads to increasing costs and falling satisfaction levels. Moscow has already stopped the operation of route taxis and has included larger buses on a regular basis in its mobility system[4].

Private cars in Russia are now not only a mode of mobility but also a symbol of free movement and the ability to move whenever and to wherever people wish. However, the growing number of cars under the existing road conditions does not solve the mobility problem and, in fact, are making mobility difficulties even worse. On the other hand, satisfaction with mass public transport and the usage of different modes of mobility (not only private cars but also bicycles and walking) heighten subjective well-being. They encourage homeostasis in the mobility domain and influence other life aspects such as housing, labor, health, and the happiness of the population.

Table 2 shows the level of motorization in several world cities and the homeostasis between the number of cars and the area size for cars in the street-road net (SRN) of these cities. In Russian cities, the SRN size is much lower than in their counterparts in different countries. What the table also shows is that the mobility level in Russian cities cannot be improved by the increasing number of private cars.

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[1] "St. Petersburgers for Public Mass Transport" [Zhiteli Sankt-Peterburga za obshchestvennyi transport]. URL: http://transport.vpeterburge.ru/ [last accessed 12 March 2018]

[2] The Moscow Department for Transport and Road-transport Infrastructure Development. URL: https://www.mos.ru/dt/ [last accessed 12 March 2018]

[3] St. Petersburg in numbers. URL: http://gov.spb.ru/helper/day/ [last accessed 12 March 2018]

[4] Degotkova I. Moscow without route taxis: disgraceful practices or care for passengers. [Moskva bez marshrutok: bezobrazie ili zabota o passazhirah] In: Novye Izvestiia. 21 September 2016. URL: https://newizv.ru/news/society/21-09-2016/247106-moskva-bez-marshrutok-bezobrazie-ili-zabota-o-passazhirah [last accessed 12 March 2018].

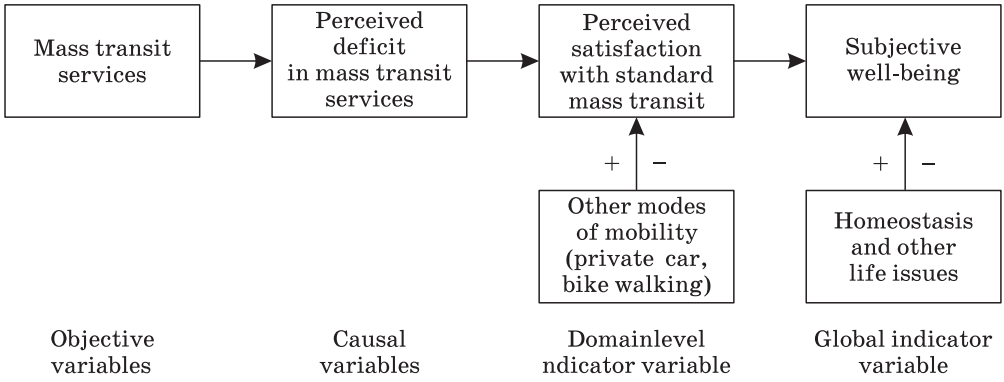

Fig. 1. The causal chain of mobility as a life domain

Table 1

The "objective" state of mobility in Moscow and St. Petersburg

N	City	Metro (stations)	Light metro	Bus	Tram	Trol-leybus	Taxi	Route taxi
1	St. Petersburg	67		681	39	45	More than 30,000	About 1,000 routes
2	Moscow	207	1 + monorail	670	46	84	More than 60,000	None

Table 2

Homeostasis between number of cars and SRN-size [22]

City	St. Petersburg	Moscow	Tokyo	Hong Kong	Singapore	London	Berlin	Paris
Population (mln)	5.2	12.1	13.2	7.1	5.3	8.4	3.5	7
Car number per 10,000 citizens	318	324	181	63	101	305	342	320
Size of SRN per car (m^2)	34	27	63	94	72	98	115	141
Territory size (km^2)	1,439	1,100 (data before enlargement)	2.2	1.1	0.7	1.6	0.9	0.8
N of trips by car per day (mln)	2.07	15.7	9.0	8.8	5.5	10.4	3.8	10.9

The application of different indicators of the Sustainable Cities Mobility Index 2017 to Russian cities (i.e. Moscow and St Petersburg, as compared in this article) provides us with an opportunity to make an in-depth evaluation of overall mobility and accessibility in St Petersburg.

Metro systems (*People* sub-index),
List of metro systems. URL: https://en.

City	Opening date	Number of lines	Number of stations	Number of trips (a year in mln)	Opening hours
St. Petersburg	1955	5	67	740.4 (2016)	19
Moscow*	1935	13	207	2,378.3 (2016)	19
Hong Kong*	1979	11	93	1,767.1 (2017)	18
Tokyo Metro*	1927	9	179	2,642.1 (2016)	19
Paris*	1900	14	302	1,518.6 (2016)	19 (21.5 on weekends and at night before holydays)
Singapore*	1987	10	119	1,008 (2014)	19
London*	1863	11	270	1,340 (2015)	Some lines 24 hrs; most lines 20 hrs
Berlin*	U — 1902 S — 80-s of the 19th century	U — 10 S — 15	U — 170 S — 166	U — 534 S — 395 (2015)	20

*Tokyo Metro is part of a large railway system, consisting also of Toei Subway, Rinkai Line, and 3751.9 million).
*RER is a combined system of city metro (inside the city center) and commuter rail (outside the
*Light Docklands Railway was opened in 1987 and consists of 45 stations. It is fully automatized.
*The central Railway Ring (the second ring of the Moscow Metro) was opened in 2016 and con-
*Hong Kong Mass Transit Railway includes heavy rail, light rail, and feeder buses.
*Singapore — with the Light Rail Transit.
*U-Bahn + S-Bahn.

Two questions can be answered with the help of the Index data: "What cities have the highest sustainability of their mobility systems?" and "Where are the Russian cities on the scale?" The first place in the overall Index and in the *People* sub-index is held by Hong Kong. The other cities in the top ten in the overall Index are, in descending order, Zurich, Paris, Seoul, Prague, Vienna, London, Singapore, Stockholm, and Frankfurt. Moscow occupies 58th place among the 100 cities listed. St. Petersburg is not included.

The sub-indexes show a different picture. In the *People* sub-index — which integrates many data about transport coverage, reliability, hours of operation, and popularity of a system — the dominance of developed countries' cities is absolute. The top 10 are, in descending order, Hong Kong, New York, Tokyo, Seoul, Beijing, Barcelona, Madrid, Paris, Singapore and London. The key indicator for the *People* sub-index is the density of metro stations and bus stops. In these cities many inhabitants prefer the use of

Table 3

including those of Moscow and St. Petersburg
wikipedia.org/wiki/List_of_metro_systems

Wi-fi	Bicycle access	Wheel-chair access
Part	No	Difficult
Only in trains	limited (disassembled and packed)	Difficult
Airport express	Limited (disassembled and packed)	Elevators at most stations
All stations	Limited (disassembled and packed)	Most stations (map on Internet)
15 stations	Metro — not permitted, RER — not in peak hours	50 stations with elevators, line 14 metro and E RER are fully equipped to allow entry to trains; other lines require help of conductors
33 stations	Limited (disassembled and packed)	Yes
For subscribers to Virgin Media	Only folded, LDR – not folded besides peak hours	Partly, special guide
Almost all stations	Yes, if there is sufficient space in a specially designated carriage	Many stations, special instructions on-site: wheel-chair travel

Yurikamome Transit. The overall number of stations in Tokyo is 309 (number of trips per year:

center). With RER, the Paris railway system consists of 560 stations.
The number of trips per year is 117 million.
sists of 31 stations interconnected with regular metro stations.

public transport to traveling with their private cars in many life situations. Most interesting in this context is that the second position is held by New York, although in the overall Index the city holds only 23rd place. The high ranking of New York in the *People* sub-index can be explained by the 24-hour operation of the metro and the good wheel-chair access to buses and metro trains.

Well-developed underground systems are in operation in all top cities. Another important feature of highly developed mobility systems is the easy accessibility of information about buses and trains, coupled with high connectedness between different elements of the systems. Table 3 shows a comparison of various features for several top 8 cities and includes data for Moscow and St. Petersburg.

Comparative analyses of underground systems show that both of Russia's largest cities have rail systems less well developed than in other cities. In Singapore the rail

system of the city-state was opened only in 1987 but already has ten lines in a combination of metro and Light Rail Transit. The first elements of a light rail are already built in Moscow, but in St. Petersburg, at the time of writing, there are once more attempts to expand the metro underground instead of taking a decision to develop a light rail on the city's periphery.

Of course, it is of interest to compare St. Petersburg on some dimensions not only with Moscow but also with other cities of the world. Many of them are quantitatively very similar in terms of surface area and population. Analyzing New York's mobility system, studies usually take into account the agglomeration New York — New Jersey (territory size: 34,500 km^2). In spite of this fact, the data in Table 4 are very similar to the indicators for Moscow and St. Petersburg according to the surface area and population size. They show clearly that systems of such dimensions and complexity have the same problems and can use similar mechanisms to solve these problems.

One of the important indicators in the *People* sub-index is the number of accidents, because safety plays perhaps the leading role among all other characteristics. The comparison of both of the largest Russian cities reflects a similar picture (Table 5).

The sub-index *Planet* is an index of the negative impacts of transport on natural resources: air, water, soil, and greenery. In St. Petersburg, 85% of air pollution is due to the various transport modes [13]. The number of private cars grew in 2016 by 38,196 units. This means that public transport does not suit all the needs of city dwellers, and they feel obliged to improve their mobility level by making the decision to purchase a private car.

In 2016 Moscow received the ITF Transport Award for the "Best transport system development results". The mobility system in the city was extensively improved in several key aspects: economic (fares were cut by 35%); technical (18 new underground stations were opened, new roads and other infrastructure elements were built); social (public mass transport services' popularity grew, from 58% in 2010 to 64% citizens preferring public transport in 2015); car sharing became a real tendency; 88,000 city bicycle trips were counted (an 8-fold increase over the number in 2014); and so on. Ecological results have also been positive. The improvement in the road conditions and the introduction of Euro-V gasoline reduced air pollution by 11%[1].

The third sub-index in the Sustainable Cities Mobility Index 2017 is *Profit*, a factor primarily connected with the economic accessibility of mass transport services for most citizens. As a rule, the average public transport fare is compared with the average salary per hour. Such a comparison shows clearly how much a city's inhabitants spend on their mobility needs (Table 6). In St. Petersburg the situation is better for citizens in comparison with other cities in the table. The mobility costs are lower.

But a very important question is also the following: "How does the mobility system influence economic development?" This problem will be analyzed in detail in the Discussion section of this article, but it is first necessary to mention some problems connected with this dependency. The authors of studies which were published as the discussion results of the roundtable "Quantifying the Socio-economic Benefits of Transport" [16] stress that a "multifaceted approach is needed" to make a transport project analysis actual for rational decision making and for attaining—through the implementation of such decisions—positive impacts on cities' and especially city-regions' socio-economic development.

4. Discussion. The results presented in Section 3 provide us with a possibility to discuss the main problems connected with the issue "life quality through mobility". This

[1] Degotkova I. Moscow has received the ITF Transport Awards for outstanding transport development results [Moscva poluchila mezhdunarodnuiu premiiu za dostizheniia v razvitii transporta]. In: Novye Izvestiia. 19 May 2016. URL: https://www.mos.ru/mayor/themes/2299/3317050/ [last accessed 12 March 2018]

Table 4

Indicators of public transport system [10]

N	City	Travel time per day (min.)	Trips % (more than 2 hours)	Average waiting time (min.)	Long waiting time (more than 20 min.) %	Distance on the trip (one way km)	Long trips (more than 12 km) %	One transfer trip %	Many transfer trips %	Walkingon one trip	Walking a day (one way more than 1 km)
1	St. Petersburg	69	20	11	16	7.3	15	70	26	0.78	26
2	Moscow	67	17	11	15	9.1	23	69	24	0.79	27
3	New-York New Jersey	87	31	15	23	9.5	26	72	23	0.69	19

Table 5

Statics of traffic accidents 2017[1]

N	City	Deaths in accidents	Accidents at crossroads	Accidents involving goods transport	Accidents involving public transport (route taxes primarily)	Involving bicycles	Involving private cars1
1	St. Petersburg	253	42 (3 killed; 56 injured)	270 (20 killed; 150 injured)	1,540 (54 killed; 1,945 injured)	245 (2 killed; 243 injured)	4,883 (265 killed; 5,894 injured)
2	Moscow	492	94 (8 killed; 120 injured)	434 (40 killed; 500 injured)	2,000 (90 killed; 2,540 injured)	269 (1 killed; 270 injured)	3,417 (157 killed; 4,340 injured)

is a multifaceted problem. One of its aspects is the inclusion and exclusion of high or low mobile population groups in a city. Public mass transport subsidized by state or municipal governments is generally financially affordable and helps to move people from one destination to another as rapidly as technically possible. Accessibility of goods and services depends primarily on the level of development of this branch of the economy in any particular city. The underground (in some cities overground or city rail, light metro), trams, buses, and sometimes ferries and water trams help city dwellers to move rapidly, comfortably, and relatively inexpensively. They “bring people and places together” [15].

[1] Statistics of traffic accidents in Russia 2017. URL: http://provodim24.ru/statistika-dtp.html [last accessed 12 March 2018]

Table 6

Comparison of public transport fares (St. Petersburg, Moscow, Berlin and Vilnius)

	St. Petersburg	Moscow[2]	Berlin[3]	Vilnius[4]
Average salary per hour	5.54$[5]	5.8$	17.5$	5.8$
Average public transport fare	0.69$ (12% from salary) [6]	0.9$ (15%)	2.9$ (17%) [23]	0.9$ (15%)
Average trip cost with transport cards, discounts, and free transport	From 0.53$ to 0.6$ (metro) "Podorozhnik" card discounts for pupils and students; free for elderly and disabled	0.6$ (10.8%) "Troika" card discounts for pupils and students; free for elderly and disabled	7-day card zoning (ABC) minimal normal fare: 4.9$ (for a day) ABC (28%) discounts for elderly, pupils, students and disabled	Vilnius card for 30 and 60 minutes, 50% discount for schoolchildren and students

[1] Statistics of traffic accidents in Russia 2017. URL: http://avtopravozashita.ru/dtp/statistika-dtp-v-rossii-za-2016-god.html [last accessed 12 March 2018]
[2] The Moscow Department for Transport and Road-transport Infrastructure Development. https://www.mos.ru/dt/ [last accessed 12 March 2018]
[3] Startseite e S-Bahn Berlin. URL: https://shop.s-bahn-berlin.de/index.php/product/65/show/0/0/0/0/buy?gclid=CjwKCAiAt8TUBRAKEiwAOI9pAI5xbxvLVXpvLNk3SrZkYdtMJGuG21mLZ56YeWlm-JxaIGLsmrzCDRoCATsQAvD_BwE [last accessed 12 March 2018]
[4] Solodova D. Public transport fares worldwide. URL: https://birdinflight.com/ru/infografica/20160517-public-transport-fares-worldwide.html [last accessed 12 March 2018]
[5] Smolnyi: The average salary in St. Petersburg exceeds 53 000 Rubles. [Smolnyi: sredniaia zarplsts v Sank-Peterburge prevyshaet 53 tysiachi rublei]. In: Kommersant.ru 25 July 2017. URL: https://www.kommersant.ru/doc/3366876 [last accessed 12 March 2018]
[6] Public transport fares will not change in 2017. In: Kommersant.ru 1 November 2017 [Ctoimost proezda v obshchestvennom transporte ne izmenitsa v 2018 godu.] URL: https://www.kommersant.ru/doc/3456018 [last accessed 12 March 2018]

The accessibility level can be measured using the general formula proposed by the participants in the International Mobility Forum 2017 [15, p. 11] for every territorial unit in a city, agglomeration, or other urbanized area. The proposed formula takes into account territorial units with boundaries, connected with some special population characteristics (number, density, social structure), political and administrative features (settlements with different types of legacy, e. g. municipalities, administrative districts), and also economic parameters (e. g. industrial sites, university towns, leisure places, resorts). According to this approach, one can measure the opportunities available in each unit (e. g. jobs, housing, culture and sports facilities) and measure the total volume of costs included in accessibility (e. g. costs of direct tickets, costs of delays, transfers, non-continuous availability of services). The accessibility costs include monetary and non-monetary costs such as time and energy. The overall measurement helps to highlight a decrease in some locations' attractiveness in situations when accessibility decreases for one reason or another.

The future of cities depends in many ways on the development of their mobility systems to connect old and new parts of the growing agglomeration and to link all economic and socially relevant destinations and all social groups into the city community. The dream of "short distances cities" [14] has not materialized. The agglomeration process is developing very rapidly, making the mobility and accessibility problem even more complicated to address. City development processes raise new accessibility issues for different locations for all opportunities (jobs, educational institutions, healthcare services, sports and leisure facilities, and so on). Connecting people with places becomes one of the tasks for state and municipal authorities. Fortunately, new computer technologies (Big Data Analysis) now make the calculation and analysis of transport metrics easier and create the possibility to plan and implement mobility projects with fewer costs and to avoid many risks.

Political problems of mass transport and road building and maintenance, along with other mobility issues, have to be included into the broader context of globalization, unification, and informatization [7]. Transportation and traffic congestion problems are often seen as dramatic issues of life in modern cities under conditions of global urbanization. As C. Doxiadis [8] noted many decades ago, the main city development goal is the human being and his/her well-being in a city, including movement within a city area. The most natural movement mode, according to Doxiadis, is walking; but modern cities often limit people's ability to move on foot, which in turn leads to the loss of human scale.

Russia's largest cities are now fully included into the globalization process, and their problems are similar to the problems of other cities in the world. But the time lag between Russia and other world cities is large: the numbers of private cars in countries with high levels of economic development are not growing as rapidly in the 21st century as they were some 40–50 years ago. Car ownership is seen there as a matter of prestige only for people who have passed from the low-income to middle-income group. The transformations in Russian society since the 1990s show very clearly a rapid growth in car ownership. In the 1990s, tram lines were removed in many places in St. Petersburg. At the same time, European cities have already begun to *restore* trams to make their mobility systems more sustainable. Unfortunately, foreign experience and other countries' earlier mistakes were apparently ignored by cities in Russia.

It is particularly important to determine the most complex mobility problems in St. Petersburg. Such an attempt was made by the City Planning Laboratory [Laboratotiia Gradoplanirovaniia] in its Analytical Report 2015[1]. Traffic congestion, overload of the road network, the growing number of private cars, overload of the metro, low safety levels, the quality of transport services for citizens and tourists, and other visible problems are coupled with deeper underlying issues such as space identity loss, slow infrastructure development in comparison with economic growth, and the city administration's slow response in the transportation sphere to the challenges typical for modern large agglomerations.

The authors of the City Planning Laboratory's report also describe several problems particular to St. Petersburg. One of these is the complex and long-term political and social transformation connected with new demands, especially those of younger citizens who have grown up already under new socio-economic conditions. Also important are changes in the production and trade sector, and the division of the region into two separate subjects of the Russian Federation: St. Petersburg, and the Leningrad Region[2].

[1] City Planning Laboratory [Laboratotiia Gradoplanirovaniia] Analytical Report "Transportation Problems in St. Petersburg to be solved on the complex planning of territorial transport system". URL: http://labgrad.ru/d/180205/d/01_analiticheskayazapiska_problemytsspb29_05_2015.pdf [last accessed 12 March 2018].

[2] The Russian Federation is composed of 85 'federal subjects'. These federal subjects are federal cities (there are 3: Moscow, St. Petersburg, and Sevastopol), oblasts (e.g. Leningrad Oblast), republics, krais, autonomous oblasts, or autonomous okrugs. Each federal subject is represented by two delegates in the Federation Council (upper house of Russia's Federal Assembly).

The role of architectural and space planning has changed, and these domains have been subordinated to the aims of investors and other economic actors [2].

The similarity of mobility problems in world cities makes it possible to search for rational decisions in relation to Russia, based on other cities' experience. For example, the number of deaths in street accidents has been decreasing in New York City every year as a result of the implementation of the city's "Vision Zero" strategy (narrow traffic lines, lower speeds, special bicycle lanes, pedestrian islands at dangerous crossings). With the arrival of new traffic participants, however, the traffic congestion in Manhattan has not changed. Uber, other operators working at below-market prices, Amazon deliveries, and many other new tendencies are bringing even more cars into the streets, particularly in the city center. The authorities and transport planners in St. Petersburg must not forget that these new players on the mobility scene are already present also in Russian cities. There is a proposal by the New York State Governor Andrew Cuomo to introduce congestion pricing for Manhattan. It could already be in place 2018 [11].

The development of city programs and strategies for mobility systems requires a fundamental analytical basis. Modern technologies, in most cases Big Data Analyses, and their implementation are connected with a very complex data collecting issue. The main question is this: "What data have to be collected and for what purpose?" This problem has been analyzed by many authors, among them the Italian scientists Carlo Cusatellia, Massimiliano Giacaloneb, and Andrea Troisic [4]. Following Doxiadis, they have created an anthropocentric model and made citizen satisfaction the central factor in the analyses of mobility systems' efficiency and the evaluation of effectiveness. Their data include metrics characterizing objective and subjective QOL parameters in mobility services, such as expected quality (expectations of citizens: subjective); design quality (goals of an administration, primarily determined normatively: objective); given quality (provision of services of definite quality compared with standard services: objective); and perceived quality (users' satisfaction with services provided: subjective) [4]. According to the mobility quality model, as a modification of the QOL model developed by Cummings (see Figure 1), it is possible to identify the homeostasis between objective and subjective parameters and dependency factors for overall well-being as a subjective category. (No matter how often it is stated in the media that the mobility in a city is high, people will not believe this when they have to wait half-an-hour in minus 20o Celsius for a bus and have no idea when the bus will arrive.)

Decision making for development of mobility systems requires in-depth analysis of an existing situation and a very strong prognostic modeling for rationalization of the whole process. This was also the goal of Romeo Danielis, Lucia Rotaris, and Adriana Monte's [5] analysis of the real mobility situation in Italian cities of different sizes, including Milan and Rome. Searching for a rational model, they tested many analysis models and created a set of indicators comprising a composite indicator which provides an opportunity to determine what mobility modes and vehicles are able to create a sustainable mobility system in large cities such as Milan (pop. 8 million in its polycentric metropolitan area) and Rome (3.2–4.2 million in the metropolitan area). These make good comparison objects for St. Petersburg, because the mobility system of the latter city extends far beyond its administrative border and requires development along with the whole metropolitan area (combined pop. more than 6.5 million). The planning issues are even more complex, given the existence of two federation subjects — and therefore two separate administrations — in this region.

QOL depends on mobility of a high grade. This problem was fully identified some decades ago and is one among a number of important research and policy issues. Political issues such as poverty, exclusion, and inequality are now discussed in the context of mobility. A special issue of *European Transport Research Review* is devoted to transport poverty and its consequences. In her editorial for the issue, the British researcher Karen

Lucas [17] from the Institute for Transport Studies (University of Leeds) characterizes four papers presenting the experience from cities functioning under different political, economic, and social conditions (Montreal, Munich, Bandung, and Beijing) and formulates a definition of mobility poverty. Elements of this definition can assist us also to determine to what extent St. Petersburg's citizens live under mobility poverty conditions.

Individuals can be defined as "transport poor" if it is difficult, partly impossible, or fully impossible to conduct their basic daily activities because they lack transport options that meet their physical needs (e. g. elderly people and people with disabilities have difficulty entering buses with high steps or metro platforms with stairs). All city dwellers need transport which reaches the relevant destinations for their work, education, and other everyday life goals (e. g. because of the lack the transport possibilities, it is a very complicated matter to reach the Mariinsky Theatre in St. Petersburg before a performance at night and to return home afterwards). Too-high costs make many routes impossible for an individual. These are not only financial costs but also over-spending of time and physical exhaustion. The chances of finding a good workplace and the possibility of optimal housing are minimal under bad mobility conditions. This also increases mobility poverty. Extreme mobility poverty is connected with safety problems, which make the QOL in a city objectively worse than in safer surrounding areas (e. g. a large number of route taxis makes streets unsafe and increases the number of road fatalities)[1].

The problems of St. Petersburg's mobility system outlined above are closely connected with global transport development tendencies and require special strategic programs. Intensive goods and people flows between St. Petersburg and Leningrad Region require integrated solutions, and these conditions are clearly understood by the authorities of both subjects of the Russian Federation. On 31 January 2013 the autonomous, non-profit organization "Directorate for Development of St. Petersburg and Leningrad Region Transport System" was created by the Government of the Russian Federation and the governments of both subjects of the Federation. The main goals of the directorate are the coordination of development tendencies, monitoring of the real/live situation, research and cooperation in the field of innovation for the improvement of mobility systems, and active participation in the implementation of priority projects[2].

In 2016 the "Development Strategy for the Transport System of St. Petersburg and the Leningrad Region" [6] until 2030 was approved by the Coordination Council for the Transport System Development in St. Petersburg and Leningrad Region. The strategic development goal is to meet the population and business demands for transport services, in accordance with accessibility, reliability, economic and safety indicators, and efficient development of transport infrastructure to enable a higher competitive power for St. Petersburg and Leningrad Region, QOL improvement, and the sustainable economic growth of both regions[3].

Since 2014 first steps have been made to develop new mobility modes such as biking in St. Petersburg. But the results are poor. City authorities are not really interested in the matter and the subsidizing of the project has been cut many times during these years. The will to win of activist groups is not enough to implement the idea.

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[1] The mobility poverty problem and its consequences are also included into the 2017 Global Mobility Report of the World Bank. Accessibility for all, safety, efficiency of transport systems and "green mobility" are defined as main development goals. See: Global Mobility Report 2017. Tracking Sector Performance. Sustainable mobility for all. URL: https://openknowledge.worldbank.org/bitstream/handle/10986/28542/120500.pdf [last accessed 12 March 2018]

[2] Directorate for development of St. Petersburg and Leningrad Region transport system. URL: http://spbtrd.ru/en/directional/ [last accessed 12 March 2018]

[3] Development Strategy for the Transport System of St. Petersburg and the Leningrad Region [Stratediia razvitiia transportnoi sistemy Sankt-Peterburga i Leningradskoi oblasti]. URL: http://spbtrd.ru/program-development/ [last accessed 12 March 2018]

Obviously, the development tendencies in Russia and particularly in St. Petersburg are seen in the same light as all over the world, and the hope is that the reality of implementation will correspond with the planning and formulated goals.

5. Instead of conclusions. In such a diverse and multifaceted issue as mobility, it makes little sense to draw definite conclusions. Some aspects are absolutely clear and do not require further comment; others are so indefinite and strongly differentiated from city to city and from country to country that each case requires special comments, or it is too early to draw conclusions. But there is one aspect which allows shedding a new light on the mobility problem.

Some truths often seem to be indisputable. All over the world billions are invested into construction of rail systems in cities (metro, light rail, and others). St. Petersburgers envy Moscow's opening of several new metro stations every year. Tram systems are being renewed and restored in cities where they disappeared in the second half of the last century. Rail has higher speed and guarantees better mobility. It is also less liable to mobility poverty because of public subsidizing. But if people ask themselves about their individual goals, they will of course prefer private cars as the most convenient and comfortable transport mode, providing them maximum freedom in the mobility domain: they are absolutely free to go where they want, when they want, and they do not depend on anybody.

The next question is whether it is possible to organize the traffic rationally with millions of private cars and other vehicles on the roads and not to destroy the rest of the natural resources in cities, in their immediate surroundings, and also in the broader spaces beyond. Some researchers suggest analyzing the new possibilities provided by fully automatic electric cars, driven by computer on the basis of Big Data Analysis (choosing routes, optimal speed, guaranteeing safety, and so on) [1]. Mechanisms of coordination and cooperation such as car sharing can be included into the scheme. Individual mobility freedom and collective interest can perhaps be integrated into a new lifestyle and improve QOL, while at the same time fighting mobility poverty, exclusion, and the destruction of nature.

Mankind is now once more at a crossroads and has to make rational and well-informed, balanced choices to ensure optimal conditions for future generations.

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