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Problem of Location of Taxi Ranks and Taxi Dispatch Service Operations in Moscow

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ABSTRACT

The article considers the technological aspects of organization of passenger and baggage transportation by taxi cabs in megacities, referring particularly to the practices of a number of countries.

The authors analyze legal regulation and technological development of taxi services in Moscow metropolitan area, including the current system for organizing the work of passenger taxi dispatch services taking into account centralization of information flows in a single city system.

An analysis of methods for planning placement of taxi ranks shows that outdated approaches are used to solve that problem without using modern information and communication technologies. In this regard, the methodological foundations of planning the organization of taxi ranks based on geo-information data in the city of Moscow are proposed.

The studies and analysis made it possible to determine relevance and feasibility of existing and justification for planning of new taxi ranks, taking into account the requirements for rationality of location of taxi ranks from the point of view of ensuring a small walking distance for passengers, as well as reducing time of car delivery.

The proposed method using accurate coordinates transmitted by the largest taxi dispatch service companies into the Unified Regional Navigation and Information System of the city of Moscow allows to implement these requirements.

Keywords: *motor transport, city transport, taxi transportation, passenger and baggage transportation, taxi ranks, planning methodology, geo-information data, efficiency increase, megalopolis.*

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Introduction. Taxi transportation is an important part of enhanced transport mobility of citizens. So, in Moscow, as of June 7, 2018, 3111 individual entrepreneurs (8 463 valid permits) and 1 147 legal entities (38 476 valid permits) carried out taxi operations [1].

In the Russian capital, taxi operations are regulated by a number of city regulations adopted on the basis of federal legislation.

In order to implement the requirements of the Federal Law of the Russian Federation of April 21, 2011 No. 69-FZ [2] in Moscow, the city of Moscow adopted Moscow City Law of June 11, 2008 No. 22 «On taxi in the city of Moscow» (updated version of June 22, 2011) [3], Decree of the Government of Moscow of July 28, 2011 No. 278-PP «On measures to implement the Federal Law of April 21, 2011 No. 69-FZ «On amending certain legislative acts of the Russian Federation» (together with the «Administrative Regulation for provision of public services in Moscow «Issuing permits, renewing permits, issuing duplicate permits and canceling permits for carrying out activities for transportation of passengers and baggage by taxi in the territory of the city of Moscow», «Regulation on the register of issued permits for implementation of activities for transportation of passengers and baggage by taxi in the territory of the city of Moscow») [4]. In accordance with these regulatory legal acts, the administrative regulations for provision of public services for issuing permits [5], the regulation on the register and the form of permits [4] were also approved.

By the Decree of the Government of Moscow dated May 15, 2012 No. 198-PP, the Administrative Regulation on fulfillment by Moscow administrative road inspectorate of the public function for implementation of regional public control over requirements in the field of passenger and baggage transportation by taxi within the territory of the city of Moscow was approved [6].

In order to increase efficiency of urban transit services, the Governments of Moscow and Moscow region signed an agreement on June 28, 2011 «On cooperation in organization of passenger and baggage transportation by taxi within the territories of the city of Moscow and Moscow region» [7].

The problem of organizing taxi activities is relevant in all major cities in the world. Legal regulation is being improved by regional and local administration [see, for example, 8: regulation in Seattle (USA), 9: in the province of British Columbia (Canada)] and, in some cases, regulation or discussion of problems is carried out at the national level [see, for example, 10: Great Britain, 11: Ireland], a large number of scientific papers (for example, [12]) are also devoted to this issue. Analyzing international experience in organizing taxi services, it can be concluded that most developed countries (megacities) have gone the way of changing approaches to regulating the taxi market from a rigid regulatory system to linearization and vice versa [13, p. 15]. The system of state control after passing through the «liberal» stage becomes more rigid and structured [14, p. 24].

Due to the interest of the Department of transport of the city of Moscow to develop a scientifically based methodology for organizing taxi ranks, expert organizations have been involved in research. So, the department of road transportation of Moscow Automobile and Road Construction State Technical University (MADI) has developed a scietific and methodological base and gained extensive experience in conducting research in the field of provision of taxi services to residents [15–20].

As a rule, when discussing and planning activities related to city taxis, the focus is on issuing licenses, wording requirements for drivers and the technical condition of the fleet, organization of dispatch services and taxi ranks.

The issues under analysis are often considered as the ratio of regulated and unregulated transportation activities, as well as the consequences of organizational and regulatory measures in the form of the ratio of the proportion of trips provided through dispatch companies, from taxi ranks and when taxi stops outside the taxi ranks. An example of such a study is [21, for example, chapter 3.1 An Overview of Taxi Markets and Regulatory Systems].

The *objectives* of this study are to identify relevant information technologies with regard to activities of taxi dispatch companies and regulation of their operations, as well as to explore possibility to use information technology to create modern methods for organizing taxi ranks in Moscow.

The authors use the *methods* of statistical and legal analysis, graphical analytical methodological tools.

Information technology and technological development of taxi transportation

The increase in the number of dispatching services for ordering passenger taxis (mobile aggregators), as well as the share of trips made through them, is largely due to saturation of the mobile Internet market in Russia as a whole, as well as in small and medium-sized cities.

According to the Ministry of Communications in the first half of 2017, mobile Internet traffic in Russia reached 2,82 billion gigabytes [22, p. 1]. Compared to the first half of 2016, it grew by almost 90 %. This is the highest growth rate in the last three years. In the first half of 2016, compared with the same period in 2015, the growth was 39 %, for the first six months of 2015 it was equal to 63 %. For the entire 2016, mobile data traffic in Russia grew by 48 %.

According to AC & M–Consulting [22, p. 1], in the first half of 2017, the monthly audience of mobile Internet amounted to 114,8 million users: this is 9 % more than a year earlier.

Given the current trends in development of mobile technologies, we can conclude that they directly affect development of car sharing trips. Sharing trips are joint travel online services where the cost of the service is reduced due to shared use of a vehicle. In the sharing system, the price of the trip is set personally by each driver. Riding sharing has become almost an alternative to public transport in Germany, Spain and France. That is why in Barcelona, Madrid, Paris, taxi drivers go on strike against such services: passengers refuse to use official taxis in favor of «private companions».

Passenger taxi dispatch services

Currently, the following main taxi dispatch companies are in the market in Moscow: Yandex.Taxi, Uber, Gett, CityMobil, Vezet, In Driver.

Yandex.Taxi is an online taxi booking service available through the mobile application or taxi.yandex.ru website. It is one of the largest passenger taxi dispatch companies (mobile aggregators) in Russia in terms of the number of orders served. The service passes the order to the driver who will be able to arrive faster, taking into account the user's location and traffic conditions.

As of April 2018, the service Yandex. Taxi worked in 126 large cities of Russia, Belarus, Moldova, Ukraine, Armenia, Georgia, Kyrgyzstan, Kazakhstan. In March 2018, the service also began operating in Latvia, and on April 4, 2018, in Uzbekistan. In total, more than 200 thousand drivers are connected to it. Available rates in different cities are different. The full line includes Economy, Comfort, Comfort+, Business and Minivan.

Gett operates in 72 cities in Israel, in more than 100 cities in Russia, in 9 cities in the UK and in New York.

Uber is a startup from San Francisco, a mobile application for finding, calling and paying for taxis or private drivers. To date, the application works in more than 300 cities in 57 countries. In Moscow, the application Uber has been running since November 2013.

CityMobil is one of the leading taxi booking services available through a mobile application, website or an operator. The history of the company dates back to 2007. Even then, CityMobil applied a progressive system: a new program was installed that allowed automated distribution of orders to the nearest car. In the field of taxi transportation, this was a technological breakthrough. Thanks to the improved service, waiting time for a car was reduced to 10 minutes. Idle runs between ordered trips decreased by an order of magnitude, which helped attract thousands of drivers to the industry. More than 20 000 drivers of Economy, Comfort and Business class work with CityMobil, operating on the basis of official permits.

Regulation of passenger taxi dispatch services

Until now, federal legislation does not regulate the activities of mobile aggregators. The Government of the Russian Federation has not implemented subparagraph «g» of paragraph 1 of the instruction of the President of the Russian Federation V. V. Putin following the meeting of the Presidium of the State Council of the Russian Federation on September 22, 2017 [23] on regulation of activities and responsibilities of aggregators.

Resolution of Moscow Government dated January 24, 2017 No. 9-PP «On measures to improve organization of taxi services in the city of Moscow and amending resolution of Moscow Government dated February 15, 2011 No. 32-PP» [24] updated regulation of the activities of taxi dispatch services in the city of Moscow.

It is fundamentally important for us that the passenger taxi dispatch services in Moscow

provide the public information system «The Unified Regional Navigation and Information System of the City of Moscow» (hereinafter – ERNIS) with an array of information, including:

• data on location of passenger taxis receiving orders with indicating the status of «free/occupied»;

• permit number for carrying out activities on transportation of passengers and baggage by a passenger taxi;

• number of the state registration plate of a passenger taxi vehicle.

The procedure for information interaction of taxi dispatch services in Moscow with ERNIS and timing for transmission of information are established by order of the Department of transport and development of road transport infrastructure of the city of Moscow dated March 06, 2017 No. 61-02-76/7 [25]. In accordance with this Regulation, transfer of navigation data from the information system of the dispatch service to ERNIS is carried out according to EGTS intersystem interaction protocol in accordance with the order of the Ministry of Transport of Russia dated July 31, 2012 No. 285 [26].

The frequency of transmission of data (navigation marks) from the onboard equipment of vehicles to the information system of the dispatch service followed by its transmission to ERNIS should be made at least once every 20 seconds or when receiving data from additional equipment.

Assessment of taxi ranks planning methodology

The issues of organizing taxi ranks are regulated abroad at the local level, and the issues of regulating their construction are referred in some cases to responsibility of self-regulatory organizations [27: technical requirements for design of taxi stops by Australian Industry Taxi Association]. The issues of organizing taxi ranks are reasonably considered both in the context of improving transport services provided to the population, and in order to regulate urban traffic congestion and increase its predictability. Examples of such approaches can be found in the practices of New York [28] and other megacities.

In any case, the problem of correct and effective organization of taxi ranks is the focus of the city authorities of many of the largest cities in the world. No less acute it is manifested in Moscow, as evidenced by the increased number of calls from the taxi community.

The research institute of road transport has developed a methodology for determining the number, location and capacity of taxi ranks [29, pp. 10–30].

The rational location of a taxi rank according to the specified method is determined by the graphic-analytical method. In the area of the city in which it is necessary to place a taxi rank, the main transport route is selected, through which large transport flows pass. On the scheme of the district with the transport highway, the areas of the microdistricts are plotted and the number of living, working or arriving population N_i is indicated. The center of gravity is determined within the area of each microdistrict and the perpendicular o_i falls onto the main transport highway. From the conditional point Z selected on the main highway, a distance to each perpendicular is found. The average distance from the conditional point Z to the rational location of the taxi lot X is calculated by the formula:

$$ZX = \frac{z_{o_1} \cdot N_1 + z_{o2} \cdot N_2 + z_{o_i} \cdot N_i}{N_1 + N_2 + N_3}, \quad (1)$$

where ZX is distance from the reference point to the taxi rank location;

Z_{Oi} is distance from the conditional point Z to the bases of the perpendicular.

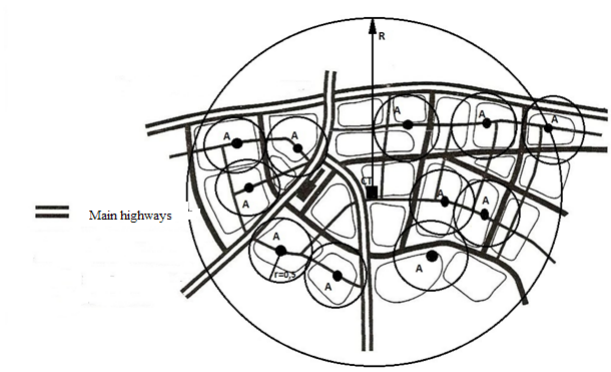
To determine the area serviced by taxi rank, a circle of radius R_{max} is drawn from the found point X, and the location points of special taxi call automatic machines are placed along the circle line so that time required to rent a taxi car does not exceed the allowable value. A taxi call machine is a device for two-way communication of a passenger with a taxi dispatcher.

The main criterion when placing points for ordering taxi cars in the city district is the maximum range of walking distance to them. According to the methodology, it should not exceed 500 meters. Time required to approach and place an order should be 10 minutes. In this case, the maximum distance of the order point from the district taxi rank can be determined by the formula:

$$R_{\max} = \frac{V_t \cdot (t\delta - 10)}{60}, \quad (2)$$

where V_t is technical speed of a car, km/h;

$t\delta$ is maximum allowable time for car delivery (including order time), min.



Pic. 1. The layout of the district taxi rank and call machines.
Legend: CT – taxi rank; A – taxi call automatic machines; R – radius of the territory served by the taxi rank; r – radius of the approach zone to the call machines.

Table 1

Coefficient of the planning structure of the city

Cities	K_{pl}
With radial and radial-ring structure of highways	1,2
With territories of residential areas and the center, divided by water, parks, large industrial zones (non-compact form of the territory)	1,6
With a compact shape of the territory and a rectangular structure of highways	1,3
Elongated areas by length, with remoteness of residential areas from places of employment for not more than 3 km	1,3
The same, but with a distance of more than 3 km	1,8

The area of the city territory served by one taxi rank (Fc) and several points of calling will be equal to:

$$Fc = \varpi \cdot (R_{\max} + 0{,}5)^2. \quad (3)$$

For example, with V_t = 28 km/h and $t\delta$ = 12 minutes, the maximum distance of the call point will be 930 meters, and the area of the city served by one taxi rank will be 6,2 km^2. The total number of taxi ranks in the city (N) is determined by the formula:

$$N = \frac{Fo}{Fc} = \frac{Fo}{\pi \cdot (R_{\max} + 0{,}5)^2}, \quad (4)$$

where Fo is area of the developed territory of the city, km^2.

The total number of automatic machines for calling taxi cars in the city is determined by the formula:

$$n_a = Fo - \varpi \cdot N \cdot R_{\max}. \quad (5)$$

The capacity of taxi rank is calculated by the formula:

$$S = \frac{A \cdot \omega \cdot \gamma_{ij} \cdot p_r \cdot t_n \cdot \eta_{vp} \cdot \eta_{pr}}{60 \cdot q \cdot l_{av}}, \quad (6)$$

where ω is coefficient of paid mileage of a taxi car which is determined by coefficients of the intra-hour peak, and respectively by the ratio of the maximum number of departures and of the maximum number of arrivals of cars during a ten-minute rush hour interval to their average value during all six intervals within a rush hour;

q – average occupancy of a taxi car, people;

γ_{ij} –proportion of travels started in the i-th district that the taxi rank serves in the total volume of travels;

p_r –coefficient of uneven hourly departures of passengers from the district;

$t_п$ – the time that a parking place is occupied by a car, min;

l_{av} – average passenger travel distance, km.

The average passenger travel distance can be determined by the formula:

$$l_{av} = 1{,}8 + 0{,}3 \cdot K_{PL} \cdot \sqrt{Fo}, \quad (7)$$

where K_{pl} is coefficient of the planning structure of the city;

1,8 and 0,3 – empirical coefficients.

The calculations allow to determine the location of the taxi ranks and automatic machines for calling taxi cars (Pic. 1).

The specified document [29, pp. 10–30] set recommendations on organization of a

Table 2

Top 10 Moscow districts where taxi rides start

No.	District	Number of starts of rides, units	% of the total number	Total %
1	Tverskoy	8009	5,85	36,52
2	Presnensky	7249	5,3	
3	Tagansky	5477	4,01	
4	Basmanny	5231	3,83	
5	Khamovniki	4410	3,22	
6	Krasnoselsky	4373	3,19	
7	Ramenki	4146	3,03	
8	Dorogomilovo	3846	2,81	
9	Meshchansky	3597	2,63	
10	Danilovsky	3576	2,61	
11–144	Other districts (on average)	1484	1,86	63,48

Table 3

Top 10 Moscow districts where taxi rides end

No.	District	Number of ends of rides, units	% of the total number	Total %
1	Presnensky	7166	5,39	35,35
2	Tverskoy	6768	5,09	
3	Basmanny	5631	4,24	
4	Tagansky	4537	3,41	
5	Ramenki	4255	3,21	
6	Khamovniki	4152	3,13	
7	Krasnoselsky	3820	2,88	
8	Danilovsky	3584	2,7	
9	Dorogomilovo	3531	2,66	
10	Lyublino	3479	2,62	
11–144	Other districts (on average)	1478	1,11	64,65

network of taxi ranks in cities with different population numbers.

The analysis of the above methodology for determining the number, location and capacity of taxi ranks has revealed a significant problem in its implementation associated with the limited free space in the city for taxi ranks. Its use is possible in practice when designing new housing estates of cities or new cities.

The methodology has a theoretical analytical character and includes many parameters, determination of which, in turn, is a serious problem. The methodology has no practical value in the conditions of market relations and for cities with well-established infrastructure. A significant drawback of the methodology is the use of outdated approaches of the planned state economy to solving the problem and not using the capabilities of modern advanced information and communication technologies.

In this regard, it becomes necessary to replace the outdated method with a more relevant and practice-oriented scheme in order to improve quality of taxi services.

The mechanism to plan organization of taxi ranks based on geoinformation

With modern development of information technology, the problem of rational allocation of taxi ranks should be solved by using fundamentally different approaches. In modern conditions, taking into account development of digital technologies, it is advisable to use big data obtained using GLONASS/GPS system when solving the problem of organizing taxi ranks. For urban planning purposes, it is possible to use data transmitted in accordance with the Regulation of information interaction from the largest taxi dispatch services to the Unified Regional Navigation and Information System of the city of Moscow [23, 24].

The analysis of statistical data on the number of transmitted statuses «free/occupied» made it

Table 4

Composition of information on start and end points of trips by passenger taxis

No.	Name of the field	Data type	Note
1	Date and time	Date	Date and time of data creation (accurate to milliseconds)
2	Latitude	Numeric	In the projection WGS84, decimal degrees accurate to 3 decimal places (± 50 m)
3	Longitude	Numeric	In the projection WGS84, decimal degrees accurate to 3 decimal places (± 50 m)

Table 5

Top 5 coordinates for the period from 00 h 00 min to 1 h 00 min

No.	Coordinates	Number of orders per hour
1	55.758 37.612	27
2	55.761 37.620	23
3	55.756 37.614	22
4	55.759 37.611	18
5	55.757 37.613	17

Table 6

Places of long-term stopping of passenger taxis in Tverskoy district of Moscow	Existing taxi rank
Mokhovaya street, Manege	There is a taxi rank
Intersection of Tverskaya street with Gazetny and Nikitsky lanes	There is a taxi rank in the immediate vicinity: Tverskaya street, 3
Intersection of Bolshaya Dmitrovka street and Kamergersky lane	There are no taxi ranks, pedestrian zone
Neglinnaya street, TSUM	There is a taxi rank
Slavic and Old squares;	There is a taxi rank in the immediate vicinity: Lubyansky passage, 25s2
Tverskaya Zastava square, Belorussky railway station	There is a taxi rank
Intersection of Theater passage and Nikolskaya street	There is a taxi rank (sign 3.27 with the sign 8.4.14 «Except taxi» is installed)
Triumphal square, 2, Mayakovskaya metro station	There is a taxi rank
Intersection of Novoslobodskaya street and Suschevsky Val	There are no taxi ranks

possible to establish areas with most frequently used (on average per day) points of start and end of taxi rides (Tables 2, 3).

To solve the problem using geoinformation data, it is necessary to determine the following composition of information on start and end points of the route of passenger taxis (Table 4).

At the first planning stage, an array of data containing information on start and end points of the route of passenger taxis should be divided into blocks by hours of the day with an interval of one hour in the context of the district.

At the second stage, it is necessary to build a ranked table (Table 5) of data on the number of locations for passenger embarkation/disembarkation.

At the final stage, an analysis of potential opportunities and modeling of the specific location of universal parking lots for taxi cars is carried out taking into account changes in the places of gravity of taxi cars in the context of hours of the day, days of the week and seasonality.

An example of the practical applicability of the results of the proposed methodology

Let us turn to the results of a study of one of the districts of Moscow called Tverskoy. As a result of the work performed using a large array of ERNIS data, the following locations were identified for the long-term stop of passenger taxis in this area. The selection was made among locations in which a large number of orders were observed for two or more hours in a row (Table 6).

Analysis of time of use of passenger taxi ranks shows their uneven filling. The survey

showed that taxi rank on Mokhovaya street near Manezhnaya square is in high demand at night after the end of work of public transport and cannot accommodate all passenger taxis. In this regard, it is advisable to consider the possibility of using additional locations for parking taxi cars at night, for example, parking for sightseeing buses.

Location at the intersection of Bolshaya Dmitrovka street and Kamergersky lane is in demand in connection with the pedestrian zone organized there. The organization of taxi ranks in this place is not possible. However, some countries allow movement and parking of passenger taxis in pedestrian areas. It is recommended to consider this possibility in the city of Moscow.

At the intersection of Novoslobodskaya street and Suschevsky Val, a large number of passenger taxi stops (for embarkation/ disembarkation of passengers) were revealed. It is recommended to locate there passenger taxi ranks.

Naturally, the same recommendations can be obtained for any other urban area.

Conclusions. The studies and analysis made it possible to determine relevance and feasibility of existing taxi ranks and the rationale for planning new taxi ranks. One of the main requirements is rationality of location of taxi ranks, providing a short walking distance for passengers, as well as reducing time of delivery of a taxi car. The proposed method using accurate coordinates received from the largest taxi dispatch services via the Unified Regional Navigation and Information System of the city of Moscow allows us to implement these requirements.

It can be concluded that this technique using the analysis of geolocation data and other proposed parameters can be adapted to the conditions of other megacities.

REFERENCES

1. The register of permits issued for carrying out activities for transportation of passengers and baggage by taxi within the territory of the city of Moscow [*Reestr vydannykh razreshenii na osushchestvlenie deyatelnosti po perevozke passazhirov i bagazha legkovym taxi na territorii goroda Moskvy*]. [Electronic resource]: https://www.mos.ru/otvet-transport/kak-proverit-razreshenie-taksi/. Last accessed 26.02.2019.

2. The Federal Law «On Introducing Amendments to Certain Legislative Acts of the Russian Federation» of April 21, 2011 No. 69-FZ (latest edition) [*Federalniy zakon «O vnesenii izmenenii v otdelnie zakonodatelnie akty Rossiiskoi Federatsii «O vnesenii izmenenii v otdelnie zakonodatelnie akty Rossiiskoi Federatsii» ot 21.04.2011 № 69-FZ (poslednyaya redaktsiya)*]. [Electronic resource]: http://www.consultant.ru/document/cons_doc_LAW_113289/. Last accessed 26.02.2019.

3. The Law of Moscow of June 11, 2008 No. 22 «On taxi in the city of Moscow» [*Zakon g. Moskvy ot 11 iyunya 2008 № 22 «O taxi v gorode Mosvke»*]. [Electronic resource]: http://www.garant.ru/products/ipo/prime/doc/290052/#ixzz5JXGszy00. Last accessed 26.02.2019.

4. Decree of Moscow Government of July 28, 2011 No. 278-PP «On measures to implement the Federal Law of April 21, 2011 No. 69-FZ «On introducing amendments to certain legislative acts of the Russian Federation» [*Postanovlenie Pravitelstva Moskvy ot 28 iyulya 2011 № 278-PP «O merakh po realizatsii Federalnogo zakona ot 21 aprelya 2011 № 69-FZ «O vnesenii izmenenii v otdelnie zakonodatelnie akty Rossiiskoi Federatsii»*]. [Electronic resource]: http://www.garant.ru/products/ipo/ prime/doc/297249/#ixzz5JXFoPgtY. Last accessed 26.02.2019.

5. Administrative regulations for provision of state services in Moscow «Issuing permits, renewing permits, issuing duplicate permits and canceling permits for the carriage of passengers and baggage by taxi in the territory of the city of Moscow», approved by Moscow Government Decree No. 278 of June 28, 2011, No. 278-PP «On measures for the implementation of the Federal Law of April 21, 2011 No. 69-ФЗ»On introducing amendments to certain legislative acts of the Russian Federation» [*Administrativniy reglament predostavleniya gosudarstvennoi uslugi goroda Moskvy «Vydacha razresheniya, vydacha dublikata razresheniya i annulirovanie razresheniya na osushchestvlenie deyatelnosti po perevozke passazhirov I bagazha legkovym taxi na territorii goroda Moskvy», utverzhdenniy postanovleniem Pravitelstva Moskvy ot 28.06.2011. № 278-PP «O merakh po realizatsii Federalnogo zakona ot 21.04.2011 № 69-FZ «O vnesenii izmenenii v otdelnie zakonodatelnie akty Rossiiskoi Federatsii»*]. [Electronic resource]: http://docs.cntd.ru/document/537906132. Last accessed 26.02.2019.

6. Decree of the Government of Moscow dated May 15,2012 No. 198-PP «On approval of the Administrative Regulation for Moscow Administrative Road Inspection to perform the state function to carry out regional state control over compliance by legal entities and individual entrepreneurs with requirements in the field of passenger and baggage carriage by taxi in the territory of Moscow city [*Postanovlenie Pravitelstva Moskvy ot 15.05.2012 № 198-PP «Ob utverzhdenii Administrativnogo reglamenta ispoleniya Moskovskoi administrativnoi dorozhnoi inspektsiei gosudarstvennoi funktsii po osushchestvleniyu regionalnogo gosudarstvennogo kontrolya za soblyudeniem yuridicheskimi litsami i individualnymi predprinimatelyami trebovanii v sfere perevozok passazhirov i bagazha legkovym taxi na territorii goroda Moskvy»*]. [Electronic resource]: https://www.mos.ru/madi/documents/taxidoc/ view/6785220/. Last accessed 26.02.2019.

7. Agreement dated June 28, 2011 «On cooperation in the field of organization of transportation of passengers and baggage by passenger taxi within the territories of the city of Moscow and Moscow region» [*Soglashenie ot 28.06.2011 «O vzaimodeistvii v sfere organizatsii perevozok passazhirov i bagazha legkovym taxi na territoriyakh goroda Moskvy i Moskovskoi oblasti»*]. [Electronic resource]: http://docs.cntd.ru/document/537908202. Доступ 26.02.2019.

8. Business Regulations. Rules for Taxis. [Electronic resource]: https://www.seattle.gov/business-regulations/taxis-for-hires-and-tncs/taxis. Last accessed 26.02.2019.

9. Modernizing Taxi Regulation. Prepared for Ministry of Transportation and Infrastructure by Hara Associates Inc. Ottawa, Ontario. Hara Associates Reference: 1570, June 8, 2018. [Electronic resource]: http://www.th.gov.

bc.ca/rpt/Documents/20180718_Modernizing%20Taxi%20Regulation.pdf. Last accessed 26.02.2019.

10. House of Commons Transport Committee. The Regulation of Taxis and Private Hire Vehicle Services in the UK. Third Report of Session 2003–04. Volume 1. Report, together with formal minutes. Ordered by The House of Commons to be printed 4 February 2004. [Electronic resource]: https://publications.parliament.uk/pa/cm200304/cmselect/cmtran/251/251.pdf. Last accessed 26.02.2019.

11. National Transport Authority. Taxi Ranks. [Electronic resource]: https://www.nationaltransport.ie/taxi-and-bus-licensing/taxi/operating-an-spsv/taxi-ranks. Last accessed 26.02.2019.

12. Rienstra, S., Bakker, P., Visser, J. International comparison of taxi regulations and Uber. Technical report. KiM Netherlands Institute for Transport Policy Analysis, 2015. [Electronic resource]: https://www.researchgate.net/publication/285235126_International_comparison_of_taxi_regulations_and_Uber/link/565caaba08aeafc2aac7184c/download. Last accessed 26.02.2019.

13. Bekken, J.-T. Regulation of taxi services market in Europe. Institute of Transport Economics. Oslo, 2003. [Electronic resource]: https://studylib.ru/doc/2472511/regulirovanie-rynka-taksomotornyh-uslug-v-evrope. [Text in Russian]. Last accessed 26.02.2019.

14. Schaller Consulting. Taxicab Fact Book, 2004. [Electronic resource]: https://www schallerconsult.com'taxi/taxifb.pdf). Last accessed 26.02.2019.

15. Bludyan, N.O., Moroz, D.G., Durin, D.S., Smyslova, Yu. S. Requirements for design, equipment and operation of taxi cars [*Trebovaniya k konstruktsii, oborudovaniyu i rezhimu raboty avtomobilei taksi*]. *Avtomatizatsiya i upravlenie v tekhnicheskikh sistemakh*, 2015, Iss. 3, pp. 173–180.

16. Bludyan, N. O., Ayriev, R. S., Akopov, F. V., Real, S. The modern model of multimodal inter-regional passenger transportation in agglomeration [*Sovremennaya model' organizatsii multimodalnykh mezhregionalnykh passazhirskikh perevozok v usloviyakh aglomeratsii*]. *V mire nauchnykh otkrytii*, 2015, Iss. 6, pp. 233–242.

17. Moroz, D. G. Some aspects of improving organization of taxi services in Moscow metropolis [*Nekotorie aspekty sovershenstvovaniya organizatsii taksomotornykh perevozok v Moskovskom megapolise*]. *Avtotransportnoe predpryatie*, 2013, Iss. 2, pp. 22–24.

18. Bludyan, N. O., Pistun, E. I., Moroz, D. G., Kheifits, P. I. Agglomeration problems of organizing an efficient transport system [*Aglomeratsionnie problemy organizatsii effektivnoi transportnoi sistemy*]. *Avtomatizatsiya i upravlenie v tekhnicheskikh sistemakh*, 2014, Iss. 2, pp. 3–13.

19. Bludyan, N. O., Moroz, D. G., Kheifits, P. I. Territorial transport forecasting and planning in Moscow metropolitan area [*Territorialno-transportnoe prognozirovanie i planirovanie v moskovskoi aglomeratsii*]. *Avtotransportnoe predpriyatie*, 2014, Iss. 2, pp. 18–21.

20. Bludyan, N. O. Problems of organizing taxi transportation in Moscow metropolis [*Problemy organizatsii taksomotornykh perevozok v Moskovskom megapolise*]. *Avtotransportnoe predpriyatie*, 2012, Iss. 10, pp. 5–8.

21. Global taxi schemes and their integration in sustainable urban transport systems. Overview Paper prepared for Expert Group Meeting on Sustainable Urban Transport: Modernizing and 'Greening' Taxi Fleets in Latin American Cities, BNDES, Rio de Janeiro, 18–19 May 2011. Prepared by Antônio Nélson Rodrigues da Silva, university of São Paulo – USP, São Carlos School of Engineering – Department of Transportation, Ronaldo Balassiano Marcio Peixoto de Sequeira Santos, Federal University of Rio De Janeiro – UFRJ, Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa em Engenharia – COPPE Transport Engineering Programme. [Electronic resource]: https://sustainabledevelopment.un.org/content/documents/synthesispaper.pdf. Last accessed 26.02.2019.

22. Sauer, Derk. Mobile Internet in Russia is growing faster [*Mobilniy internet v Rossii rastet vse bystree*]. *Vedomosti*, 1999, September 18, 2017. [Electronic resource]: https://www.vedomosti.ru/technology/articles/2017/09/18/734306-mobilnii-internet. Last accessed 26.02.2019.

23. The list of instructions following the meeting of the Presidium of the State Council [*Perechen' poruchenii po itogam zasedaniya prezidiuma Gossoveta*]. [Electronic resource]: http://www.kremlin.ru/acts/assignments/orders/55932. Last accessed 26.02.2019.

24. Decree of Moscow Government dated January 24, 2017 No. 9-PP «On measures to improve organization of taxi services in the city of Moscow and amendments to the Decree of Moscow Government dated February 15, 2011 No. 32-PP» [*Postanovlenie Pravitelstva Moskvy ot 24.01.2017 № 9-PP «O merakh po sovershenstvovaniyu organizatsii taksomotornykh perevozok v gorode Moskve i vnesenii izmeneniya v postanovlenie Pravitelstva Moskvy ot 15 fevralya 2011 № 32-PP»*]. [Electronic resource]: https://www.mos.ru/ authority/documents/doc/35928220/. Last accessed 26.02.2019.

25. Order of the Department of transport and development of road transport infrastructure of the city of Moscow dated March 06, 2017 No. 61-02-76/7 «On approval of the Regulation for information interaction of passenger taxi dispatch services in Moscow with the Unified Regional Navigation and Information System of the city of Moscow [*Prikaz Departamenta transporta i razvitiya dorozhno-transportnoi infrastruktury g. Moskvy ot 06.03.2017 № 61-02-76/7 «Ob utverzhdenii Reglamenta informatsionnogo vzaimodeistviya dispetcherskikh sluzhb zakaza legkovykh taksi v gorode Moskve s Edinoi regionalnoi navigatsionno-informatsionnoi sistemoi goroda Moskvy»*]. [Electronic resource]: http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=MLAW&n= 177335&dst=100001#06527366221921675. Last accessed 26.02.2019.

26. Order of the Ministry of Transport of the Russian Federation of July 31, 2012 No. 285 «On approval of requirements for navigation aids functioning using navigation signals of GLONASS or GLONASS/GPS system and intended for mandatory equipping of vehicles of category M used for commercial transportation of passengers and of category N used for transportation of dangerous goods [*Prikaz Mintransa RF ot 31 iyulya 2012 № 285 «Ob utverzhdenii trebovanii k sredstvam navigatsii, funktsioniruyushchim s ispolzovaniem navigatsionnykh signalov sistemy GLONASS ili GLONASS/GPS i prednaznachennym dlya obyazatelnogo osnashcheniya transportnykh sredstv kategorii M, ispolzuemykh dlya kommercheskikh perevozok passazhirov i kategorii N, ispolzuemykh dlya perevozki opasnykh gruzov»*]. [Electronic resource]: http://www.garant.ru/products/ipo/prime/doc/70129002/#ixzz5KMleED15. Last accessed 26.02.2019.

27. Flexible arranged transport using taxi-cabs and maxi-cabs. [Electronic resource]: https://www.iru.org/apps/cms-filesystem-action/Events_2012_taxiforum/AnnexB.pdf. Last accessed 26.02.2019.

28. Congestion Reduction Policies Involving Taxis. Prepared for New York City Economic Development Corporation, New York City Department of Transportation. Prepared by Cambridge Systematics, Inc. Technical memorandum 2007. [Electronic resource]: https://www.dot.ny.gov/programs/repository/Tech%20Memo%20on%20Cab%20Policies.pdf. Last accessed 26.02.2019.

29. Bolonenkov, G. V. Increasing the efficiency of using taxi ranks [*Povyshenie effektivnosti ispolzovaniya taksomotornykh stoyanok*]. Ministry of Road Transport of the RSFSR, TsBNTI. Moscow, 1976, 35 p.