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Research Paper

Experts on Resistance to Reorganization of Structure and Technologies of Urban Mobility Provision in Russia: Challenges, Reasons, Solutions and Prospects

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Abstract

In 2022 a lot has changed in the Russian transport system. Today the urban transport systems of Russian cities are staying at the bifurcation point – they are awaiting serious changes. Therefore, it was interesting to investigate expert opinions of specialists on the prospects of the development of urban mobility provision technologies in Russia and possible changes in the current structure of citizens' transportation approaches. The paper gives results of the research of opinions of transport market specialists on the issues of the probability of the shift of the current paradigm of transport services in Tyumen (a large Russian city with a population of 828.5 thousand people) and the necessity of reorganization of the structure and technologies of urban mobility provision due to the withdrawal of foreign automakers from the Russian market. The article presents the comparison of opinions between Tyumen professionals in the transport market and ordinary Russian citizens. The main conclusion of the research considers the serious resistance of the public environment to the expected reorganization of the structure and technologies of urban mobility provision in Russia.

Keywords: Urban mobility provision; MaaS (Mobility-as-a-Service); FMoD (Flexible-Mobility-on-Demand); Urban public transport (UPT); Personal automobile transport (PAT)

1. Introduction

In the spring-summer of 2022 Russia witnessed a giant imbalance between the high demand for new cars and the almost total absence of their supply on the market. According to Rosstat [1], the production of new automobiles in the Russian Federation in May 2022 decreased by 96.7% compared to May 2021. Sales of new cars collapsed by 83.5% in May 2022. Almost all foreign automobile manufacturers announced their withdrawal from the Russian market [2]. Prices for the remaining on the marker cars sharply doubled and tripled. The solvency of potential car buyers in Russia has plummeted [3]. As a result, experts estimate the current situation in the Russian automobile market in the summer of 2022 as catastrophic [4].

At the same time acute crisis on the market of production and sales of new cars is almost invisible against the backdrop of 60.1 mln. vehicles [5] of current Russian automobile fleet. The actual intensity of exploitation of these vehicles in 2022 in Russia even increased due to stable enough (at the level of 2021) fuel prices [6]. Considering the fact that the overall inflation in the first half-year of 2022 amounted to about 11.4% [7], Russian car owners feel profited. Russians who postponed car purchase until better times lost out.

Therefore, the question arises about medium-term and long-term prospects of the services market in the sphere of Russian citizens' mobility provision. How much current crisis, associated with the withdrawal of almost all global car

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manufacturers from Russia, will affect the future of the mobility market? What awaits the mobility market for citizens of Russian cities where more than 75 % of the Russian population currently lives?[8] We need to realize the perspectives of structural changes in the sphere of urban mobility provision technologies. Is there any chance of the sharp growth of demand for MaaS (i.e. Mobility-as-a-Service) or FMoD (i.e. Flexible-Mobility-on-Demand) services in Russia in the conditions of crisis in the car production sphere? The responses to these questions were obtained during in-depth open interviews with Russian experts in the transport sphere and the analysis of results of google-survey among Tyumen residents.

The purpose of the research was to examine the opinions of professionals, located and working in the large Russian city Tyumen, on the immediate prospects of restructuring and qualitative changes in urban mobility technologies in Russia and to compare these opinions with the views of ordinary citizens.

The most important contribution of this article is the results of a study of the current situation (2022) in the use of various options for ensuring the mobility of the urban Russian population. The main emphasis is placed on the study of the attitude of Russians to the possible change of the paradigm of transport mobility from the use of motor transport to the MaaS-paradigm.

2. General Information on the Car Fleet in Russia and Approaches to Implementing Population Transport Mobility

2.1. Dynamics of Development of Car Fleet in Russia in 1992…2021 and Its Current State

Over the past 30 years (1992–2021) automobilization in Russia has only increased, reaching today the level of A_{2021} = 415 vehicles / 1000 people [5]. In 1992 automobilization in Russia was A_{1992} = 60 vehicles / 1000 people [9]. Thus, during 30 years the level of automobilization has increased by almost 7 times. The growth rate varied at different periods. The average rate was about 9…15 % per year in the first decade (1992–2001); about 6…8 % per year in the second decade (2002–2011) and about 2…5 % per year in the third decade (2012–2021). Over the last four years (2018…2021) car fleet in Russia has grown by about 1.0…1.2 mln. units per year (i.e. by 1.8…2.0 %). By the beginning of 2022, there were 60141.9 thous. registered vehicles in Russia [5]. The major part of them (near 82 %) were cars of urban citizens and they were exploited mostly in cities (there are 1117 cities in Russia, 15 of them are cities with a 1+ mln. people population) [10].

Below we consider the structure of the transport vehicle fleet in Russia.

A large share (about 76 %) of all vehicles in Russia are passenger cars, the fleet of them consists of 45.8 mln. units [11]. The second largest segment is the light commercial vehicles (LCV), which occupies 7 % of the fleet and has 4,2 mln. vehicles. Trucks and trailers / semi-trailers occupy 6 % each (3.8 mln. units and 3.5 mln. units respectively). The fleet of motor vehicles includes 2.4 mln. motorcycles, mopeds, and scooters (4 %). Buses are the smallest category of vehicles in Russia, the share of which is less than 1 % of the fleet (0.44 mln. units) [11].

As we consider the urban population mobility, then first of all we should analyze the state of the passenger cars fleet. The brand structure of the passenger cars fleet in Russia in 2021 [11] is presented at **Figure 1**.

According to the data of agency Autostat, the passenger cars fleet in Russia includes 112 different brands [12]. Meanwhile, only 25 brands make up 93.6 % of the passenger cars fleet. 34.5 % of the passenger cars fleet consists of formally Russian brands (AutoVAZ, GAZ, UAZ, Oka) [12].

Figure 2 shows the Pareto distribution [13] of the passenger cars fleet in Russia by brands (as of 2021).

The first 10 automakers from a ranked list (under 9 % of all brands) account for 73.3 % of all passenger cars in Russia. The structure of sales of new cars in 2021 formed differently. The growth of the Russian car fleet (≈ 1.2 mln. units) formed from the registration of 1.667 mln. cars and the decommission of 0.5 mln. cars [14]. In 2021 1666780 cars of 52 different brands were sold [14].

Figure 3 shows the distribution of the market of new passenger cars in Russia (by the results of sales in 2021) [14].

Figure 4 presents the Pareto distribution [13] of the market of new passenger cars in Russia by brands (by the results in sales in 2021).

The first 10 automakers from a ranked list (under 20 % of all brands presented at the market in 2021) account for 77.4 % of all sales of new passenger cars in Russia. The formally Russian

brands (AutoVAZ, GAZ, UAZ) were responsible for 26.6 % of sales of new cars. Three-quarters of the cars sold in 2021 in Russia are cars from foreign automakers, the withdrawal of which is extremely painful for Russians. In 2021 the share of sales of foreign-brand cars in Russia (73.4 %) exceeded the analogous share of the current fleet (65.5 %). This fact clearly illustrates the tendency of the increase of the significance of the production and sales of foreign-brand cars in the last years.

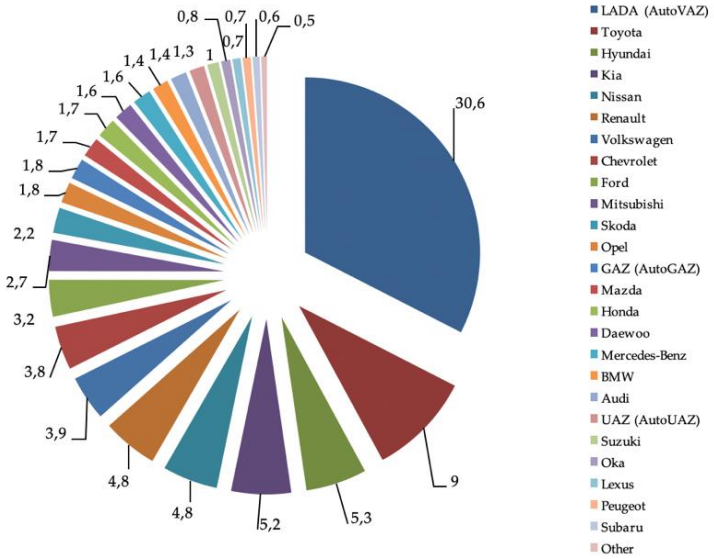
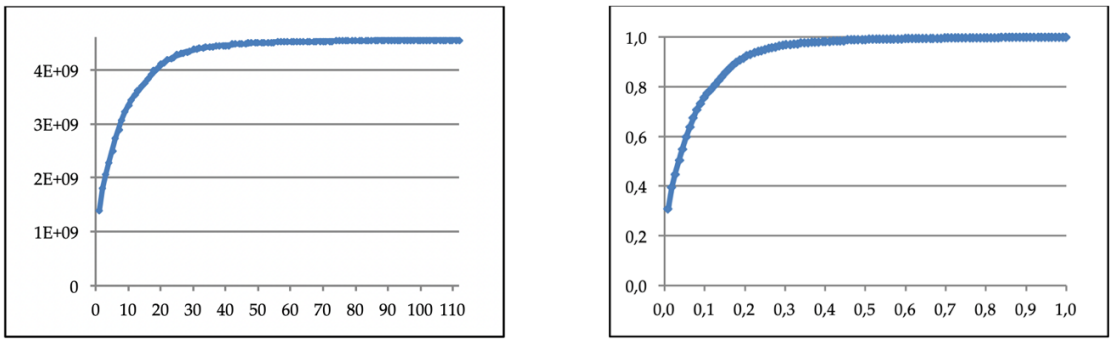


Figure 1. The structure of the Russian fleet of passenger cars, % (as of 2021) [11]



(a) Pareto-diagram (b) Normalized Pareto-diagram

Figure 2. Pareto-distribution of the passenger cars fleet in Russia by brands (as of December 2021) [12]

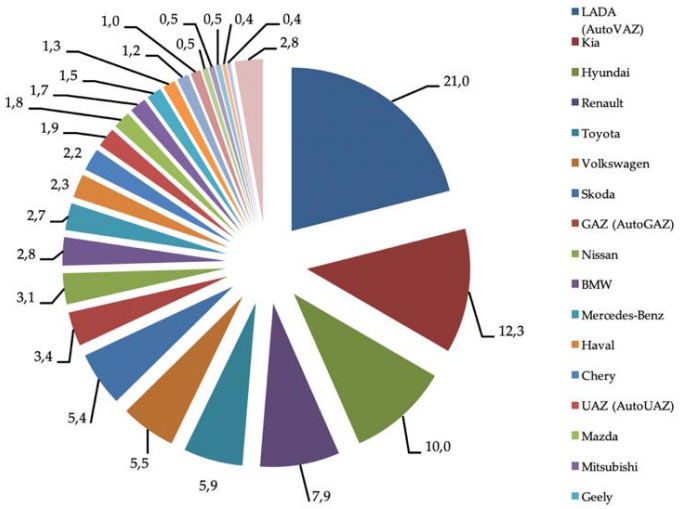
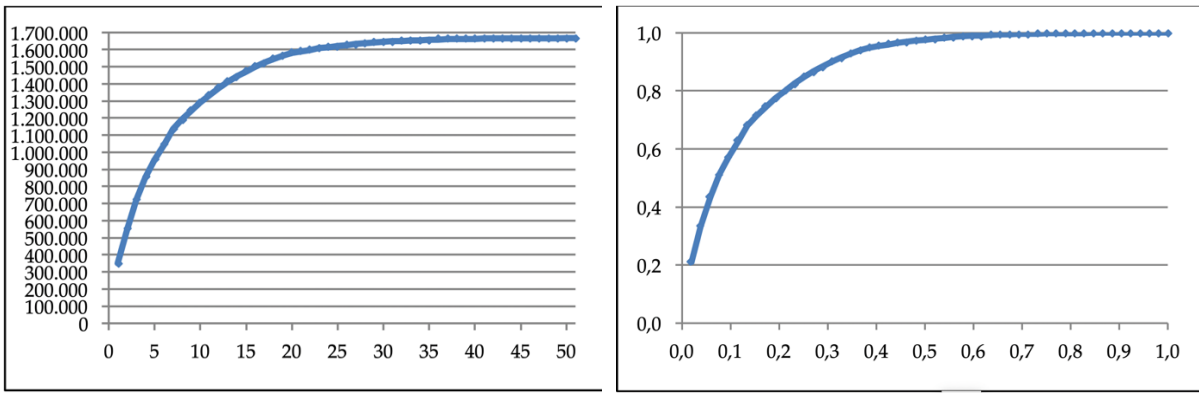


Figure 3. Sales of new passenger cars in Russia, % (2021) [14]



(a) Pareto-diagram (b) Normalized Pareto-diagram

Figure 4. Pareto-distribution of the market of new passenger cars in Russia by brands (by the results in sales in 2021) [13]

2.2. *Approaches of Implementation of Urban Mobility by Country's Population*

Today (2021) Russian population consists of 145.5 mln. people. The gender and age structure of Russians (2020) [15] is presented in **Figure 5**. Legal restrictions allow driving a car in Russia only if the driver reaches the age of 18 [16]. There are practically no senior drivers (age above 80 years) in Russia. Hence there is an informal restriction on the age of Russian citizens allowed to drive vehicles [17]. The analysis shows that about a quarter of Russians (24.6 %) are forced (due to the age of ineligibility to drive vehicles or old age) to use third-party (public or shared) services for transport mobility and only 75.4 % of Russian citizens theoretically can use personal cars. Only half (415 / 754 = 0.55 or 55 %) of those who have a theoretical possibility of driving a personal car (A_{2021} = 415 vehicles / 1000 people) at least occasionally drive a car in reality. The second half (more accurately 45 %) of Russians can't use a personal car for the implementation of their transport mobility and they are forced to use public transport services or MaaS (FMoD) technologies.

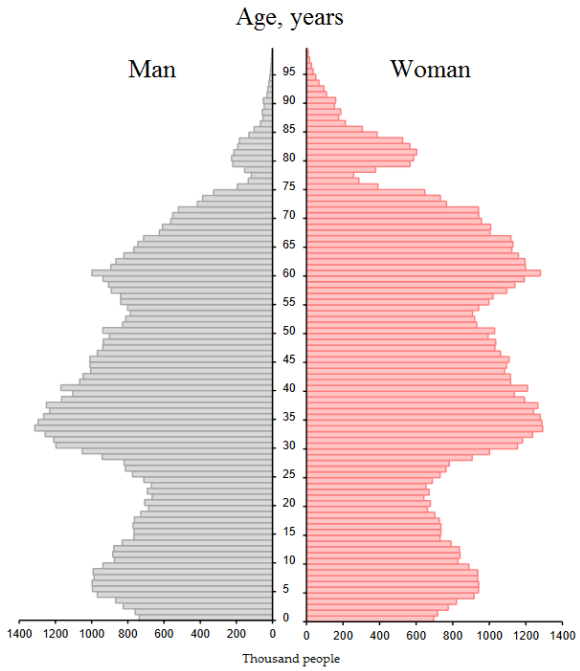


Figure 5. The chart of the distribution of Russia's population by gender and age [15] [At the age below 18 years – 30.376 mln. Russians (20.7 % from overall population); At the age above 80 years – 5.716 mln. Russians (3.9 % from overall population); About a quarter (24.6 %) of Russians are forced to use third-party (public or shared) services for transport mobility]

3. General Definitions and Technological Changes in Providing Urban Mobility

3.1. *Mobility-as-a-Service (MaaS) and Flexible-Mobility-on-Demand (FMoD) – General Definition and Distinctive Features*

Mobility-as-a-Service (MaaS) as a technological solution for the problem of spatial displacement of a citizen can be described differently. Various definitions of MaaS agree that "MaaS can be defined as: The provision of transport as a flexible, personalised on-demand service that integrates all types of mobility opportunities and presents them to the user in a completely integrated manner to enable them to get from A to B as easily as possible" [18] or "MaaS, a multi-actor environment that provides seamless door-to-door services for end users bycombining several modes of transportation" [17]. Some of the core characteristics of MaaS

implementation [19]–[25] are listed in **Table 1**. Bike- and scooter-sharing systems are a good example of the concept MaaS (**Figure 6**).

In [26] the combination of all MaaS-features is defined as «Flexible-Mobility-On-Demand». Concepts «Mobility-as-a-Service» (MaaS) and Flexible-Mobility-on-Demand (FMoD) are similar but not identical.

Flexible Mobility on Demand (FMoD), as defined by the US Department of Transportation, is a new concept based on the principle that transportation is a commodity where modes have economic values that are distinguishable in terms of cost, journey time, wait time, number of connections, convenience, and other attributes. FMoD enables consumers to access mobility, goods, and services on demand by dispatching or using shared mobility, delivery services, and public transportation solutions through an integrated and connected multi-modal network. The most advanced forms of FMoD passenger services incorporate trip planning and booking, real-time information, and fare payment into a single user interface. Passenger modes facilitated through FMoD providers include: Car-Sharing, Bike-sharing, Ride-sharing, transportation network companies (TNCs, also known as Ride-sourcing and Ride-hailing), Scooter-sharing, Microtransit, Shuttle services, Public transportation, and other emerging transportation solutions.

While there are some similarities, FMoD differs from the emerging European concept of Mobility-as-a-Service (commonly referred to as MaaS). FMoD focuses on the commodification of passenger mobility and goods delivery and transportation systems management, where as MaaS primarily focuses on passenger mobility aggregation and subscription services. Brokering travel with suppliers, repackaging, and reselling it as a bundled package is a distinguishing characteristic of MaaS. The similarities and differences between FMoD and MaaS can be best explained using **Figure 7**.

Table 1. Characteristics of MaaS implementation [19]–[25]

Characteristics	Description
Integration of transport modes	The provision of transportation «from door to door»
One platform	The provision of the ability to plan a trip using mobile services
Multiple actors	Integration of several transport types in one whole
Tariff option	The possibility of the choice of optimal tariff system from several possible
Use of technologies	MaaS is enabled through the integration of technologies such as Wi-Fi, 3G, 4G, LTE, and GPS, e-ticketing, e-payment, Internet-of-Things (IoT) and database management systems through mobile devices or computers
Registration requirement and Personalisation	The services provision is possible only after personalization, however at the same time each individual person is proposed with the most beneficial offer
Custom setting	The provision of the ability to customize settings of suggested services

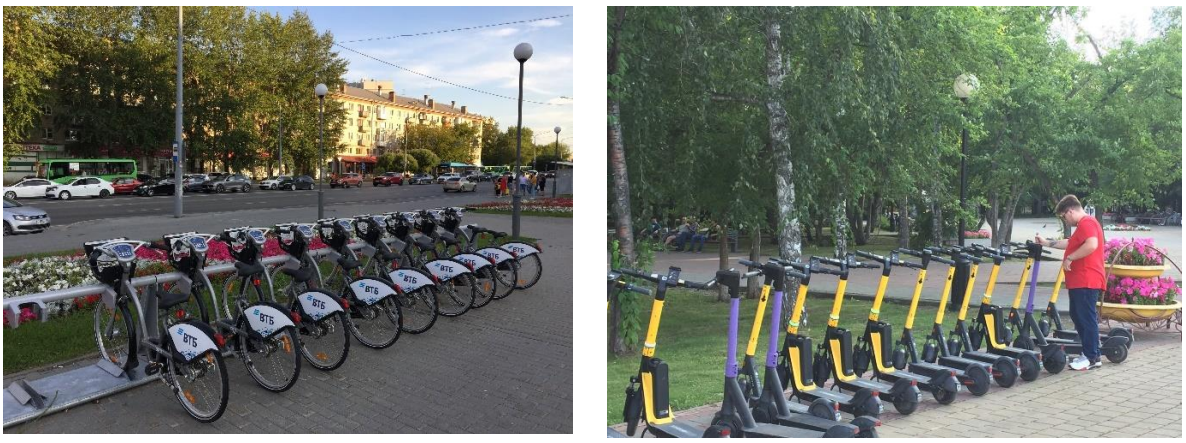


Figure 6. Photo example of organizing a bike- and scooter-sharing system in Tyumen

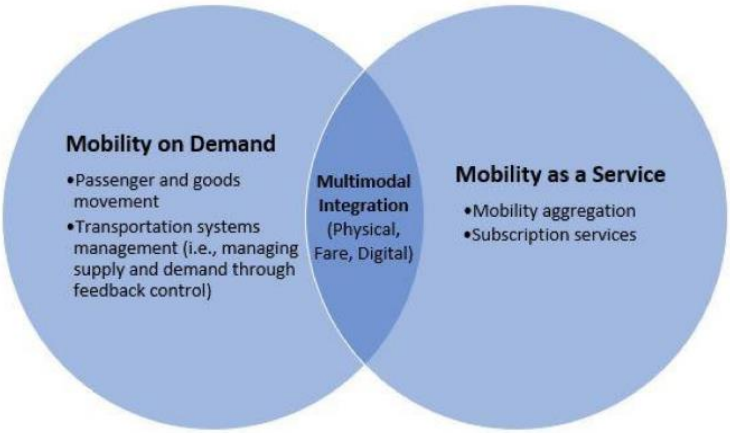


Figure 7. The similarities and differences between FMoD and MaaS

Resource [27] provides two historical examples of the first experiments in the sphere of collaborative mobility. In 1983–1985 Purdue University conducted an experiment on the cooperative use by 12 families of different-sized cars – MAV (minimum attribute vehicle or 'small car') and executive «large» cars. The experiment didn't reveal the change in drivers' habits but allowed them to obtain serious fuel savings.

Another example – The STAR (short-term auto rental) project was undertaken in the San Francisco area between 1983 and 1985. The aim of the project was to demonstrate that it was possible to live in an American City without owning a motor vehicle. The project was a partial success, with those who made infrequent trips electing to forgo private vehicle ownership (and in some cases saving as much as U$ 1000 a year). During the last 40 years humanity came a long way in the implementation of collaborative use of transport vehicles. Today all technologies of FMoD and MaaS can be conditionally differentiated into Car-Sharing Services, Bike-Sharing Services, E-Hailing, Public Transport Innovations [26].

3.2. *The Change of Technologies of Urban Mobility Provision; Public Resistance and Optimistic Perspectives*

This section presents the results of the analysis of previous papers on the research of society's resistance to the integration of modern technologies of urban mobility provision.

Maximal attention to this theme was paid at the end of the XX and the beginning of the XXI centuries. The list of the most significant works on this topic includes papers of T. P. Hughes [28], F. W. Geels [29], [30], W. B. Arthur [31], R. R. Nelson et al. [32], [33], W. Walker [34], D. Leonard-Barton [35], M. Tushman et al. [36], A. Grubler [37], N. Nakicenovic [38]. These works are devoted to the history of humanity's transition to the automobile era. The conclusions made by these authors about the regularities of mobility technologies change at the beginning of the XX century can be extended to today's reality. Article [30] examines the history of the transition pathway from horse-drawn carriages to automobiles (1860–1930). The important accomplishment of this research is a conclusion (**Figure 8**) that the advantages of any transport technology don't become obvious immediately, they need time to show their competitive benefits.

F. W. Geels [30] explains this process next way: «First, the elements in the socio-technical regime de-align early in the process, because of internal tensions and pressure from the landscape level. Second, the instability of the regime creates space for the emergence and development of multiple innovations in different niches. When these innovations promise solutions to the regime problems or link up positively with wider landscape changes, they will easily receive attention and funding. Third, the transition involves a pattern of widening up and narrowing down of the number of innovations. Opening up occurs early in the process, followed by a co-existence of different innovations for a long time. These innovations may have parallel and sequential interactions, and lead to socio-technical knock-on effects in markets, user preferences and practices, cultural meaning and infrastructure. Eventually the number of alternative options narrows down and one option becomes dominant».

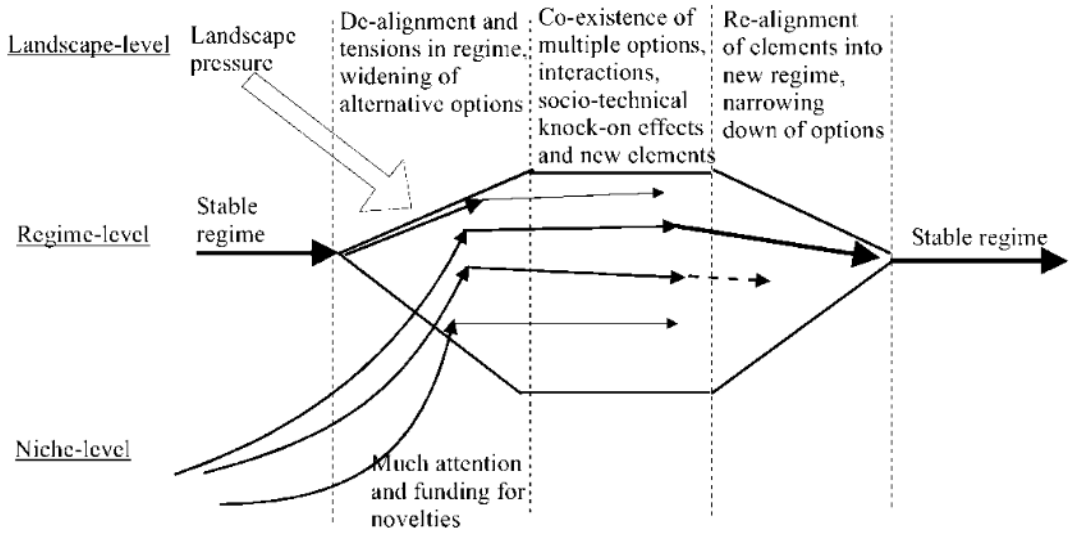


Figure 8. De-alignment and re-alignment transition pathway [30]

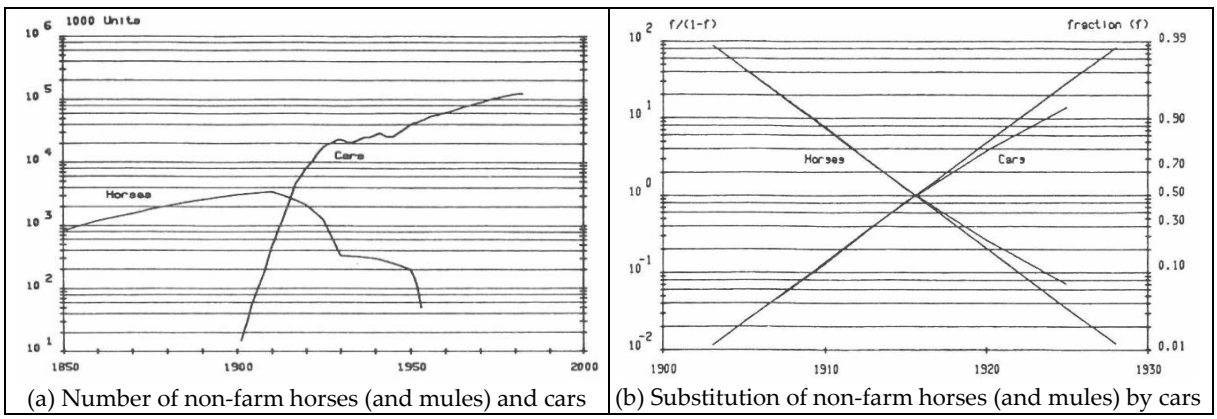
A. Grubler [37] proposed to understand long-term transitions as a techno-logical substitution process. Their basic assumption is that the replacement of an old technology by a new technology proceeds along the logistic substitution curve (1):

$$f / (1 - f) = \exp(a \cdot t + b) \quad (1)$$

where:

t : independent variable representing some unit oftime;
a,b : constants;
f : fractional market share of the new competitor;
(1-f) : fractional market share of the old one

Nakicenovic [38] presented the model (1) for the case of the USA in graphic mode (**Figure 9**). Today when the level of world urbanization exceeded 53 % and, in some countries, it reached the 90…100 % level the next change in urban mobility technologies will certainly happen [39]. At the same time, society's resistance to progress can be already observed. Works [40]–[43] to some degree consider this theme. For example, K.M. Davidson et al. [40] considered issues of sustainability of city society from a socio-political view and concluded that any society has resistance to innovative approaches in any sphere of life. R.F.M. Ameen et al. [41] pointed out that the change of technologies of energy supply in urban transport was going hard despite the requirements of ecological safety. H. Alwaer et al. [42] wrote that citizens' relation to the choice of mobility approach is incorrect and incompetent from the view of city's benefits. V. Cappuyns [43] reminded about the importance of consideration of social practice in the process of making management decisions. The main accent of his work was made on the study of reasons for



(a) Number of non-farm horses (and mules) and cars (b) Substitution of non-farm horses (and mules) by cars

Figure 9. Graphic illustration of the model (1) for the case of the USA [38]

society's resistance to the integration of modern urban technologies, including urban mobility technologies. One of the conclusions of his work was that citizens often resist innovations, in particular innovations in the MaaS-sphere.

Despite the conservative resistance to innovations in urban mobility provision sphere of separate citizens part, technological solutions of MaaS have been continuously implemented in different cities of the world. Consulting companies feel optimistic about the sprightly development of this market. Analytics from Verified Market Research predict the growth of the Mobility-as-a-Service world market from U$ 49,7 bln. in 2019 to U$ 271,7 bln. in 2027 [44]. The forecast of Market Research Future about the growth of the Mobility-as-a-Service world markets even more optimistic. Experts of Market Research Future evaluate the average annual growth of MaaS until 2024 at a rate of 39 % per year. In 2024 the volume of the MaaS-services world market will reach U$ 484,2 bln. [45]. Russian experts also feel optimistic about the development of the MaaS-market in Moscow [46]. However, it should be noted that Russian analytics are optimistic about the development only concerning Moscow and St. Petersburg. These are megapolises where 1/6 part of the Russian population lives. Specialists in the regional socio-economic development of Russia predict that modern MaaS-technologies will come to the Russian hinterland only in the next 6…30 years [47]–[49].

4. Research Methods

4.1. *Information About Current Distribution of the Market of Urban Mobility Provision Services in Russian Cities*

There is no unified and absolutely correct data on the differentiation of the market of urban mobility provision services in Russian cities [50]. However, the study of indirect statistical characteristics allows us to make conclusions about the dynamics of the change in the significance of sectors (urban passenger transport (UPT)/personal automobile transport (PAT)/ mobility-as-a-service (MaaS)). Analysis of these data allows to estimate the sectoral distribution of the transport services market.

The volume of transportations by UPT decreased from 28.5 bln. pass./year to 10.5 bln. pass./year or by 63 % in Russian cities during 1992–2021 [51]. At the same time, the level of automobilization increased by 7 times. In addition, the annual mileage of personal automobiles increased too. By extrapolating these data, we can state that the market of urban transport services (UPT / PAT / MaaS) redistributed in favor of PAT. Presumably, taking into account the level of personal automobilization [51], in 1992 the distribution of the urban transport services market was estimated as (UPT / PAT / Maas = 95% / 4% / 1%). Taking into account the change in volume of passenger transportations and the growth of intensity of PAT usage, today (2022) the structure of the market of urban transport services can be estimated as (UPT / PAT / Maas ≈ 38 %/ 57% /5 %). Therefore, the market of urban mobility services has dramatically changed over the last 30 years in Russia. The significance of PAT has highly grown; the importance of UPT decreased; the MaaS sector showed growth but its share in the overall structure is still not too large (under 5 %).

A hypothetical situation in an individual city can be generalized to other country's cities [52]. Nevertheless, we need to remember that different cities are at various levels of evolutional development in general and in particular in the transport sphere. It means that different cities pass the same stages of transport system development but at different times. Technological solutions of MaaS-sphere (i.e. car-sharing or collaborative usage of bicycles, and electric scooters) were familiar to Moscow citizens back in 2011–2012 and in other cities these solutions were implemented later. In Russian cities with 1+ mln. population sharing systems (in relation to bicycles, electric scooters, and later cars) began to integrate and actively develop in 2013–2016. In Tyumen (city's population of 828.5 thousand people) transport sharing came only in 2018–2020. In many small Russian cities, these technologies are not in demand but that doesn't mean that later they will still be not in demand. We will consider the research problem on the example of Tyumen. Today Tyumen is one of the most successfully developed Russian cities [53]. The transport system plays an essential role in the qualitative development of Tyumen.

The main research problem was formulated as a determination of the consolidated opinion of

experts in the Tyumen transport market and ordinary residents of Tyumen on the issues on the subject «Is it possible to crucially change the current paradigm of transport service in Tyumen? What is the probability of reorganization of structure and technologies of urban mobility in the conditions of the withdrawal of world automakers from the Russian market?».

4.2. *The Methodology for Solving the Stated Problem*

To get the answer to the question of readiness of transport sphere specialists to challenges in a conceptual change of urban mobility technologies, the authors conducted open deep interviews with 14 professionals who work in Tyumen and represent the university, government organizations, private transport companies, and rental transport companies (**Table 2**). Interviewees can be considered as experts in their work areas.

Table 3 presents themes that were discussed with professionals. There were 7 topics, each one included main questions. During the discussion concepts «Mobility-as-a-Service (MaaS)» and «Flexible-Mobility-on-Demand (FMoD)» were generalized to «Mobility-as-a-Service (MaaS)», as unambiguously understood by all experts.

Interviews were open and the moderator (the research author) only set themes for discussion and then the interviewee expressed his opinion. Open discussion encouraged the interviewee to reason his position. The duration was regulated by the possibilities and desires of interlocutors (approximately 40…60 minutes). The general position of the interviewee on each theme was clarified by the final question with unambiguous answer interpretation.

Table 2. Characteristics of experts in the sphere of Tyumen urban transport system

Identification	Position (2022)	Work experience, years
Employees of technical universities (transport specialization)		
Expert 1	Professor of Transport Institute of Tyumen Industrial University, head of the department, Advanced Doctor in Engineering Sciences	43
Expert 2	Professor of Transport Institute of Tyumen Industrial University, head of the department, Advanced Doctor in Engineering Sciences	39
Expert 3	Associate Professor of Transport Institute of Tyumen Industrial University, head of the department, Ph. D. in Engineering Sciences	22
Expert 4	Associate Professor of Transport Institute of Tyumen Industrial University, Ph. D. in Engineering Sciences	15
Employees of municipal (government) organizations in the sphere of Urban Transport		
Expert 5	Chief expert of the Department of Road Infrastructure and Transport of Tyumen Administration	16
Expert 6	Leading expert of Road Infrastructure and Transport of Tyumen Administration	12
Expert 7	Director of municipal institution «TyumenCityTrans», Ph.D. in Engineering Sciences	22
Expert 8	Deputy director of municipal institution «TyumenCityTrans», Ph.D. in Engineering Sciences	20
Employees of private transport companies (Urban Passenger Transport segment)		
Expert 9	Director of the largest auto transport company in Tyumen (A_c = 609 units)	19
Expert 10	Deputy director for operational work of the largest auto transport company in Tyumen (A_c = 609 units)	13
Expert 11	Director of private passenger auto transport company (A_c = 82 units)	15
Expert 12	Director of private passenger auto transport company(A_c = 56 units)	12
Employees of individual mobility provision companies (MaaS-segment)		
Expert 13	Director of private taxi company (A_c = 72 units)	2
Expert 14	Executive director of private company «The first carsharing operator in Tyumen «Cars 7»	1,5

Table 3. Main questions of open discussion with experts of possible prospects on the reorganization of the structure and technologies of urban mobility provision in Tyumen

No	Main theme of discussion with experts	Main questions for discussion
1	Attitude to Program of comprehensive development of transport infrastructure (PCDTI), Program of a comprehensive scheme of traffic management (PCSTM), and Program of a comprehensive scheme of public transport services organization (PCSPTSO); evaluation of their viability.	1. How necessary are transport planning documents? 2. How do you assess the quality of these documents? 3. How realistic are the realizations of the plans of the PCDTI, PCSTM, PCSPTSO?
2	The current state of the urban mobility market (structure and technologies).	1. How do you assess the distribution of the Tyumen transport services market between UPT, PAT, and MaaS (2022). 2. How do you assess the dynamics of this distribution during the last 10 years?
3	The current and future role of MaaS in mobility provision for Tyumen citizens; potential dynamics of its change.	1. How do you estimate the current share of the market of personal mobility per MaaS-sector in the provision of labor, household, and entertainment transportations? 2. How can the functionality of MaaS-technologies change in the next 10…15 years?
4	Do you observe a crisis in the transport services market at the current moment? (in relation to UPT and PAT)	1. Do you the evaluate current situation in the urban transport sphere as a crisis one? 2. What do you think about the current situation in the sphere of new car sales? Can this situation make a qualitative impact on the change in transport preferences of Tyumen citizens? 3. What to expect in the next 2…5 years – restructuration of new cars market (in favor of Russian and Chinese cats) or change in mobility market structure in favor of MaaS?
5	Is reorganization of structure and technologies of urban mobility provision required?	1. Do the structure and technologies of urban mobility provision need fundamental reorganization? 2. Has the moment of the necessity of reorganization of structure and technologies of urban mobility provision already come in 2022? 3. If yes, what are the main reasons for occurred necessity? 4. If not, when to expect these changes?
6	Challenges of the current moment and reasons for the inevitability of structural changes in the Tyumen mobility market.	1. Which circumstances define the necessity of structural changes in the Tyumen mobility market? 2. Are these circumstances inevitable? 3. What are the reasons for this inevitability?
7	Possible management decisions and general prospects on the integration of MaaS-concept in Tyumen.	1. Do you have a general understanding of the strategy of integration of MaaS-concept in Tyumen? 2. What problems might be encountered during the integration of the MaaS-concept in Tyumen? 3. How much more efficient are the MaaS-technologies than UPT and PAT? Give proportional evaluation. 4. Can you predict when a balanced structure of the transport services market (UPT / PAT / MaaS = 1/3 : 1/3 : 1/3) will be achieved in Tyumen? 5. What are the conditions when MaaS will take a leading place in the urban mobility provision sphere in Tyumen?

To compare the results of deep interviews with specialists and generalized public opinion, the authors conducted a closed (with the ability to choose an answer from the suggested ones) mediated covering google-survey (**Table 4**) among ordinary citizens on the main questions related to the theme of MaaS-development in Tyumen. This sample (N = 409) is a reference one. Its purpose is to compare the opinions of experts and ordinary residents. The questionnaire was simple and included only 5 questions.

The results of google-survey were used to form a general worldview opinion of generalized typical Tyumen citizen about the current situation and prospects of integration of MaaS-technologies in residents' lives. In addition, the researchers were interested in comparing opinions on MaaS perspectives in Russian cities by professionals in the transport services market and ordinary citizens.

5. Results and Discussion

5.1. Results of Open Interviews with Professionals

The first impression after conducting interviews with specialists in the Tyumen transport sphere was that experts have a distrust of MaaS-technologies significance and deny its importance in comparison to UPT and PAT. Further, we will consider experts' opinions gradually.

The first group of questions was devoted to transport planning documents - Program of comprehensive development of transport infrastructure (PCDTI), Program of a comprehensive scheme of traffic management (PCSTM), and Program of a comprehensive scheme of public transport services organization (PCSPTSO). All 14 experts agreed that these documents are necessary and their implementation (even taking into account their possible correction) is quite useful for the city transport system. The common opinion was summarized by expert 9: *«Whatever the quality of documents, their existence and attempt to implement them is better than their absence»*.

The second group of questions was devoted to the evaluation of the current state of the urban mobility market and the role of MaaS in this market. At this theme opinions of experts were not so consolidated; interviewees' professional deformation and corporate ethics influenced their views. Representatives of the university environment (experts 1, 2, 3, 4), representatives of municipal (government) organizations in the urban transport sphere (experts 5, 6, 7, 8), and em-

Table 4. Questions of the closed mediated covering google-survey of Tyumen residents on the MaaS theme

No	Question	Answer options
1	What do you think is the share of MaaS-technologies (which don't relate to the use of personal transport vehicles) in the implementation of the transport needs of Tyumen citizens? Give an answer in % relatively to the overall urban mobility market (choose only one answer).	A). Insignificant (1…2 %); B). About 5 %; C). 6….10 %; D). 10…15 %; E). More than 15 %
2	What are the limitations of the growth of MaaS-segment share in the urban mobility market? (choose only one answer).	A). Infrastructural; B). Weather and climate; C). Features of the mentality
3	Has the share of MaaS-technologies usage at transportations market grown in last 3 years? (choose only one answer).	A). Yes; B). No; C). I don't know
4	Will the current situation related to the withdrawal of foreign automakers from the Russian market in 2022 make an impact on the expansion of the MaaS-segment? (choose only one answer).	A). Yes; B). No; C). I don't know
5	If you chose answer A) in the fourth question, then evaluate in % the possibility of potential expansion of the MaaS-segment in the urban mobility market during the next 5 years. (choose only one answer).	A). Extremely insignificant (by 1…2 %); B). By 3...5 %; C). By 10 %; D). By 15…20 %; E). Extremely significant (by 25…33 %)

ployees of private transport companies in Urban Passenger Transport segment (experts 9, 10, 11, 12) advocated for the importance of the growth of UPT segment and the necessity of government support (including the growth of budget municipal expenses). Experts 13 and 14 opposed them and made arguments in defense of the free market. These opinions differ in the worldview basis. Expert 1 told that *«UPT is significantly more efficient than other options from the economic point of view»*. Expert 7 supported the previous expert: *«We are finishing the stage of large investments in reconstruction of Tyumen road-transport system. Our next phase will be the development of UPT»*. Expert 9 stated: *«In the conditions of current situation UPT is getting more significant than before»*. Representatives of the MaaS-sector conversely think that the future of urban mobility belongs to sharing and personal mobility vehicles. Expert 13 proved: *«Taxi sector has been developing for 8 years without stopping and it doesn't have a crisis»*. Expert 14 gave an opinion: *«Gradually but continuously our clients – mostly young people – have got more interested in rental services. Today we don't have problems with clientele»*. Also, he evaluated the growth of MaaS-segment by 500…600 % during 2021…2022: *«During COVID-pandemic many people refused public transport service and became our clients»*.

Quantitative estimations of Tyumen transport services market distribution between UPT, PAT, and MaaS (2022) split. Experts from university environment (experts 1, 2, 3, 4) agreed on distribution UPT / PAT / MaaS ≈ 45 % / 50 % / 5 %. Employees of municipal (government) organizations in urban transport sphere and employees of private transport companies (experts 5, 6, 7, 8, 9, 10, 11, 12) agreed on distribution UPT / PAT / MaaS ≈ 50 % / 45 % / 5 %. Experts working in MaaS-sphere are sure that the share of MaaS in Tyumen is higher – up to 10…20%, UPT, and PAT equally share remained market (40…45% each).

The third group of questions was dedicated to the estimation of the distribution of MaaS-transportations by purposes (labor, household, entertainment) and the dynamics of its change in the future. Almost all experts think that the majority (up to 95…98 %) of transportations with the use of MaaS-technologies happens for entertainment. Expert 10 said: *«Electric scooters will not replace public transport. Their function is to entertain»*.

During the discussion of the MaaS-technologies future, almost all experts agreed that everything will be determined by the citizens' quality of life in the future. Expert 11 noticed: *«Today UPT serves working people. If there are no working people tomorrow, then there will be no one to transfer»*. Expert 12 notices: *«MaaS is interesting for those who have a lot of free time. Working people don't have too much free time for entertainment. UPT is an appropriate transport type for them»*. Experts from university (experts 1, 2, 3, 4) noted that in the future much will be determined by government policies. In particular, it is known that by 2035 the Government of Russia is going to introduce payment for PAT for the usage of road-transport infrastructure [54], [55]. That can make an impact on the change of MaaS functionality. Expert 2 spoke out about that: *«We don't know what will happen in the next 10 years. If there are problems with the budget, then people will be forced to change their opinion about MaaS. Probably part of transportations will be redistributed from PAT and UPT to MaaS due to financial reasons»*.

The fourth group of questions was related to a discussion of the current state of the Tyumen transport sector and the impact of the withdrawal of foreign automakers from the Russian market. None of the experts estimated the current situation as a crisis but they had different arguments. Experts from university (experts 1, 2, 3, 4) think that the annual loss of 1,0…1,5 % of transport vehicles will not be a sensitive event during the next several years. Argumentation was based on statistical and demographical calculations. Expert 3 said: *«Today's generation of people under 30 has quite a small size. Young people don't have a passionate desire for car possession which was typical for previous generations of young people. Most likely the drop of car sales market will be inconsequential for them»*. Expert 4 supported this opinion: *«I'm 37 years old and I represent the previous generation but I also have quite a calm attitude to the fact of the personal car presence. I and my family use public transport»*. Experts who represent transport organizations and companies (experts 4, 5, 6, 7, 8, 9, 10, 11, 12) doubted that the current crisis in the new car sales sphere can qualitatively change the UPT services market. On the other side decline in the life quality of the population, a decline in their

income, and the growth of the life cost can lead to an increase in demand for UPT services. Experts 7 and 8 agreed on the next: «Today the usage PAT is quite cheap for Tyumen citizens. If PAT exploitation gets more expensive, people will switch to UPT. But we don't expect this trend on a global scale». Restructuration of new cars market is also not expected. All 14 experts feel optimistic. But expert 3 supposed a possibility of extension of car exploitation period as in «the Cuban scenario»: *«Today average age of the fleet in Russia is 12 years. People may care about their cars and use them for 20…25 years until the full wear»*.

The fifth group of questions was directed at the discussion of the strategy of management of the Tyumen transport system in medium-term and long-term prospects. Almost all experts stated that there is no necessity for a reorganization of the structure and technologies of urban mobility provision in Russia and in Tyumen in particular. Experts 9 and 10 agreed that *«everything should develop evolutionally»*. Expert 9 said: *«In the 1990s there was a deficit of personal cars – and everyone needed a personal car. Today needs of people in PAT are satisfied. And we are waiting for the development of the tendencies in favor of UPT. But I don't expect the global growth of MaaS»*. According to experts, the current (summer 2022) situation doesn't require the reorganization of the structure and technologies of urban mobility provision. Expert 1 said about a possible reason for future reorganization: *«It is possible in the conditions of sharp and significant decline of the common socio-economic situation in the country»*. Therefore, experts are sure that the reorganization of structure and technologies of urban mobility in Tyumen won't be global.

The sixth group of questions continued discussion about possible structural changes in the Tyumen mobility market but from the position of the challenges of the current (2022) moment. We wanted to figure out the circumstances that can dramatically change the necessity of structural changes in the Tyumen mobility market. Almost all experts (except expert 14) agreed that the most important and most possible reasons for necessity appearance are negative circumstances of socio-economic crisis in the country, which can't be predicted by interviewed experts. But everyone thinks that this challenge will determine the future of the transport services market and its redistribution between UPT, PAT, and MaaS.

In the end questions of possible management decisions and general perspective of implementation of the MaaS-concept in Tyumen were discussed. This set of questions resulted in the widest range of opinions. Only one expert (expert 3, representative of the university) has a mature idea of the possible strategy for implementation of the MaaS-concept in Tyumen. There were partial (in the sphere of their competencies) views on ways of realization of the MaaS-concept in Tyumen by experts 13 and 14. Experts 9, 10, 11, 12, representing private UPT organizations, haven't ever thought about the strategic potential of MaaS and haven't considered this concept as a competitor to their business. Experts 5 and 6 know that the development of MaaS is one of the most important parts of their job but they think that priority of this work is not obvious. Experts 7 and 8 consider MaaS-technologies as the issue of the distant future.

Experts are sure that the integration of MaaS is a problem for business communities and the government just should not interfere with it. Also, experts noted as an important problem the absence of a legal environment for the tasks of integration of MaaS-technologies. According to expert 3, the most significant problem is a provision of safety to consumers of MaaS-technologies and pedestrians. Today there is no special road infrastructure in Tyumen (**Figure 10**).

Issue of comparison of efficiency between MaaS and PPT, PAT technologies triggered heated discussion. Representatives of university society (experts 1, 2, 3, 4) at first refined from which positions the efficiency should be considered and then found it difficult to give an estimation. The opinions of representatives of municipal organizations (experts 5, 6, 7, 8) were divided. Employees of «TyumenCityTrans» (experts 7, 8) supposed that the implementation of MaaS-technologies can be 10…20 times cheaper in comparison to UPT and about 50…150 times cheaper in comparison with PAT. Representatives of the Tyumen Administration (experts 5, 6) gave a more conservative estimation. In their opinion, the cost difference doesn't exceed more than 5…15 times. The executives of private transport companies (experts 9, 10, 11, 12) were outraged by

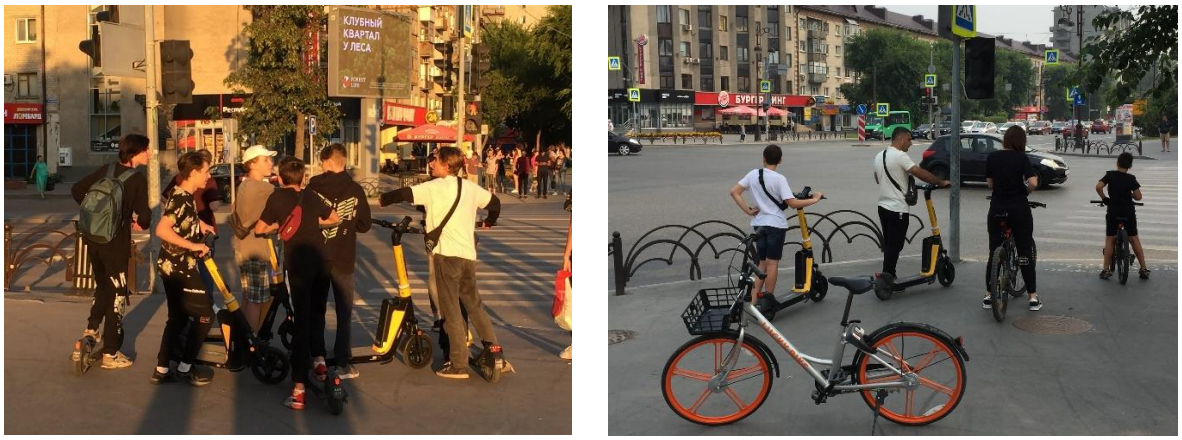


Figure 10. Photo evidence of collective usage of pavements by pedestrians and bicyclists (Tyumen, July 2022)

the question. Expert 9 stated: «*It is impossible to consider MaaS as an independent way of realization of citizens' transport requirements. It is not UPT or PAT and you can't talk about efficiency in this case. MaaS can't provide citizens' transport needs*». Experts 13 and 14 as MaaS-sector representatives were more loyal in their answers. Nevertheless, they also said that we can't compare MaaS-technologies with UPT and PAT. Expert 14 said: «*It's generally about different things*».

It derives the answers to the question about the possibilities of a balanced structure of the transport services market (UPT / PAT / MaaS = 1/3 : 1/3 : 1/3) in Tyumen. Consolidated opinion of all experts: «*It will never happen, at least in the next 50 years*». In conclusion, the experts were asked the question «What are the conditions when MaaS will take a leading place in the urban mobility provision sphere in Tyumen?». All experts ignored this question and expert 9 added that he «*hopes we won't live to see it*».

Synthesis of professionals' opinions on possibilities and prospects of reorganization of the structure and qualitative changes in urban mobility provision technologies in Tyumen allows us to make a conclusion about a great citizens' resistance to urban mobility transformation. Experts only confirm that fact. Consequently, it is early to talk about a pivotal change in the currently active paradigm of passenger transport services in Tyumen. And it is definitely incorrect to say that the withdrawal of foreign automakers from the Russian market can make a significant impact on the reorganization of structure and urban mobility provision technologies.

5.2. *Results of Closed Mediated Covering Google-survey of Citizens on the Prospects of Development of MaaS Transport Services in Tyumen*

Figure 11 to **Figure 15** presents results of the closed mediated covering google-survey (N = 409) of Tyumen citizens on MaaS-theme.

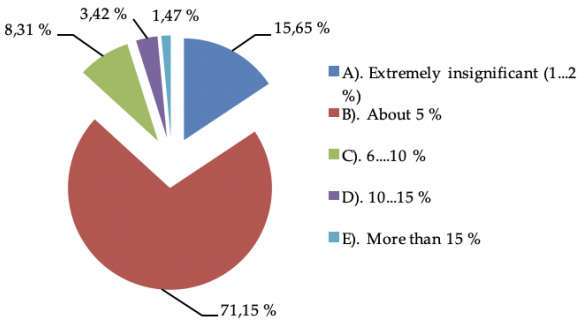


Figure 11. Distribution of answers (N = 409) of Tyumen residents on question № 1 about the place and importance of MaaS technologies in realizing the transport needs: (a) Extremely insignificant (1...2 %) – 64; (b) About 5 % - 291; (c) 6....10 % - 34; (d) 10...15 % - 14; (e) More than 15 % - 6

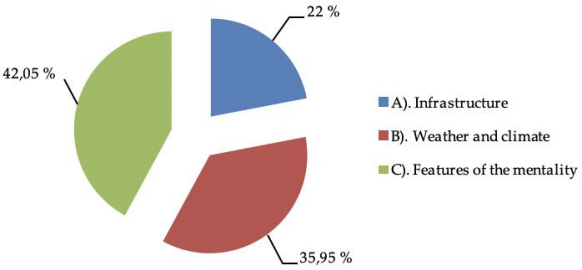


Figure 12. Distribution of answers (N = 409) of Tyumen residents on question № 2 about the factors limiting the growth of the share of the MaaS sector: (a) Infrastructure – 90; (b) Weather and climate – 147; (c) Features of the mentality – 172

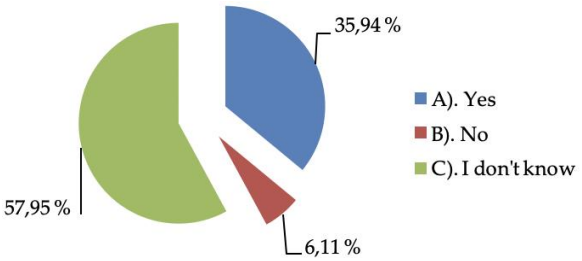


Figure 13. Distribution of answers (N = 409) of Tyumen residents on question № 3 about growth opportunities for the MaaS technology market: (a) Yes – 147; 11,98 (b) No – 25; 39,85 (c) I don't know – 237 48,17

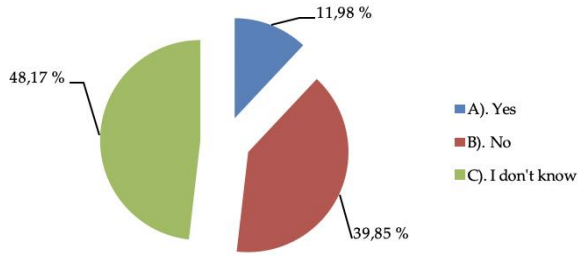


Figure 14. Distribution of answers (N = 409) of Tyumen residents on question № 4 about the impact of the current situation in Russia on the possibilities of expanding the MaaS segment: (a) Yes – 49; 11,98 (b) No – 163; 39,85 (c) I don't know – 197; 48,17

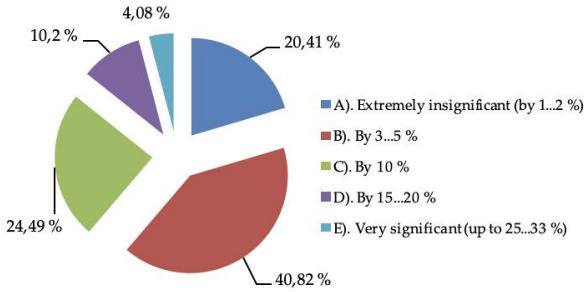


Figure 15. Distribution of answers (N = 49) of Tyumen residents on question № 5 about the potential of the MaaS segment expansion: (a) Extremely insignificant (by 1...2 %) – 10; (b) By 3...5 % – 20; (c) By 10 % – 12; (d) By 15...20 % – 5; (e) Very significant (up to 25...33 %)–2

5.3. Comparative Conclusions

Opinions of experts and city residents overlapped in three aspects:

- estimation of the share of MaaS in the transport services market in summer 2022 – about 5 %.
- skepticism to the potential of the growth of MaaS services market – consolidated estimation – during the next 5 % the possible growth is by about 3…5 % (up to 8…10 %)
- low estimation of the impact of the withdrawal of foreign automakers on the development of the MaaS-sector.

Other aspects of the potential of the MaaS-sector growth were evaluated differently by professional society and city residents. Professionals were more critical probably due to their professional deformation. Residents estimate the potential of the growth of MaaS-technologies in the market as more optimistic than experts. Citizens are less beware of infrastructural restrictions but at the same time, they were more concerned about «features of mentality» that was almost not mentioned by professionals. That is a significant factor for Tyumen citizens and it will be hard to neutralize its impact on the development of the MaaS-services sector.

6. Discussions

6.1. Application of the Theory to Russian Practice – Challenges and General Reasons of the Resistance to the Reorganization of Urban Mobility Structure

During the research authors obtained quite unexpected for the world society but not surprising for authors results. Analysis of opinions of experts and citizens showed that they have a consolidated view of the structure and technologies of urban mobility provision. They think that «today there is quite a rational relation between UPT, PAT, and MaaS in the Tyumen urban mobility sphere. This rationality is determined by the current state of the environment. These proportions are not going to change fast and dramatically; even if the share of MaaS in the structure of Tyumen citizens' mobility grows in the future the growth will be insignificant». We can state that there is serious public resistance to a gradual reorganization of the structure and technologies of urban mobility provision in Russia.

It is a known fact that public consciousness is extremely sustainable [56], [57] and it is difficult to reconstruct it. Russian society is not ready to consider MaaS-sector from the positions of the provision of labor and everyday mobility. Today MaaS in Russia is perceived as entertainment and it will be hard to change society's relation to it. It is a serious challenge for the organizations of transport services in Tyumen. Specialists should seriously study the experience of the countries that have already passed stages of MaaS-sector growth. The promotion of MaaS-technologies gets more complicated due to the philosophy of

rejection of the Western lifestyle that is actively cultivated in recent times in Russia.

One more serious reason for the slowdown of MaaS-technologies development is a relatively low cost of exploitation of PAT (to a lesser extent) and UPT (to a greater extent). Russian population spends little on transport – the expenses of UPT users on transport are less than 3…4 % of income; the expenses of PAT users are about 10…15 % of income [58].

The last but not the least reason for the slowdown of MaaS-technologies development in Russian cities is the conservatism of Russians. Demographic analysis of users of MaaS-technologies in Tyumen showed that almost 90…95 % of users are young and active people aged 15…25 years. Their share in the overall city's population is relatively small (**Figure 5**). But this category of citizens maximally actively use MaaS-technologies [59]. Change of views of middle- and senior-age people will be a serious challenge to transport specialists. At the same time in Moscow MasS-technologies are actively used by people of different ages [46]. This controversy in relations between capital residents and the population of the Russian hinterland is a significant problem that seriously distinguishes Russia from any European country in this sphere.

Famous expert in the energy carrier market M. Krutikhin [60] argumentatively states about the coming decline of life quality of the majority of Russians. This prediction is based on the fact that restrictive sanctions of the sixth EU package of sanctions targeting Russia (published on 3.06.2022) will start to fully work in February 2023. The validity of his forecast estimates was confirmed by the results of July 2022 [61]. According to the operational statistics of the Russian Ministry of Finance in July 2022, the total volume of oil and gas revenues of the treasury fell by 23 % [61].

The forecast of the Russian Ministry of Finance for 2023–2025 budget is optimistic [62] but no one can know precisely what will happen with Russian economics in six months. Today oil and gas sector provides 30…33 % of all Russian budget [60].

The collapse of this income can fundamentally change the whole country's budget-distributions system. This will inevitably negatively influence the financing of the development of different sectors (UPT / PAT / MaaS) of Russian urban transport systems. Currently (2022) in Tyumen the proportion of financing of sectors is (9 % / 90,5 % / 0,5 %).

The distribution of citizens' transportation volume between PPT / PAT / MaaS significantly differs (**Table 5**).

Works [63], [64] by Polish authors present results of the research on the issue of the success of the implementation of modern innovations in companies, represented collaborative mobility market (MaaS). Unfortunately, K. Turoń et al. [64] concluded that «Research results show that open innovation is a problematic aspect for operators. On the one hand, they are interested in it, but this interest does not translate into real practices». Russian problematics slightly differ but it also shows a serious resistance of the external environment to the implementation of new practices or urban mobility in Russian cities. Nevertheless, it is predicted that in the coming years the value of the Global Ride-Sharing Market will increase from U$ 85.8 bln. in 2021 and reach U$ 185.1 bln. in 2026 [65].

Table 5. Opinions of experts on the structure of urban transport services (UPT / PAT / MaaS) market in Russia in 2022

The structure of urban transport services (UPT / PAT / MaaS) market in Russia in 2022		
№ opinion	**Opinion's author**	**UPT / PAT / MaaS, %**
In the largest Russian cities (with the 1+ mln. people population)		
1	Scientific research institute of auto transport NIIAT [50]	≈ 38 % / 57 % / 5 %
In Tyumen (population in 2022 - 828,5 thousand people) – according to the results of research		
2	Experts from university environment (experts 1, 2, 3, 4)	≈ 45 % / 50 % / 5 %
3	Employees of municipal (government) organization in urban transport sphere (experts 5, 6, 7, 8, 9, 10, 11, 12)	≈ 50 % / 45 % / 5 %
4	Representatives of MaaS-sector (experts 13, 14)	≈ 40…45 % / 40…45 % / 10…20 %

6.2. Application of the Theory to Russian Practice – Possible Decisions in the Urban Mobility Provision Sphere and Prospects of Their Implementation

Work [66] gives logical structure behind the practical approach to decision-making (**Figure 16**) that can be used in the strategy of MaaS-technologies promotion in Russia.

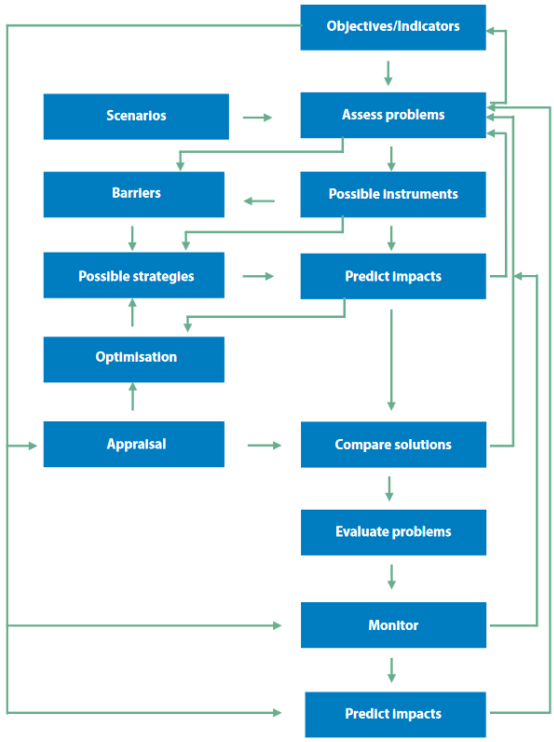


Figure 16. Logical structure behind the practical approach to decision-making [66] [Note: Based on this generalized theoretical approach strategies of reorganization of structure and technologies of urban mobility provision in Russia should be developed. There could be several strategies; managerial decisions of these strategies will be compared for the presence of problems and their severity to the society]

Today (2022) representatives of the municipal authority of Tyumen (and of other Russian cities, except Moscow and Saint Petersburg) are not ready for the development and implementation of strategies of reorganization of structure and technologies of urban mobility provision that have been already tested in other countries. The actual solution to mobility problems that has been implemented in Tyumen is the introduction of time-based payment for parking in the city center. This solution has been implemented gradually for the gentle adaptation of the population and it has already worked.

Prospects of implementation of reorganization of structure and technologies of urban mobility provision can be estimated as complex but gradually implemented. As experience shows managerial tasks are solved slowly but confidently and inevitably. Therefore, the issue of the promotion of MaaS-technologies will be solved but it will take plenty of time. The implementation of this issue in individual Russian cities could take about 10…30 years.

7. Conclusion

a. The MaaS sector in the structure of ensuring the mobility of residents of Russian cities exists and is gradually developing. However, the practical implementation of MaaS-technologies in Russian cities is limited.

b. Most experts doubt the significant growth prospects of the MaaS-technology sector. The same opinion is typical for ordinary residents of Tyumen. Consolidated assessment of professionals in the transport sector and ordinary residents of Tyumen – over the next 5 years, the MaaS sector can grow by no more than 3...5% (up to 8...10%).

c. The conclusions of experts, involved in the research, on the current rational proportion between UPT, PAT and MaaS sectors in the Tyumen transport system can change to the opposite even tomorrow. The current proportion of UPT / PAT / MaaS in Tyumen is determined by the actual (2022) economical Russian state. It can dramatically change in 2023. Consequently, the conclusion about the immutability of UPT /PAT / MaaS proportions can rapidly and unexpectedly change.

d. Today a serious imbalance has formed in Russia between investments in the development of different urban transport systems sectors and volumes of citizens' transportation processed by these sectors. In case of the decline of municipal budgets, there will be a need for the change of the structure of the urban transport services (UPT / PAT / MaaS) market to acceptable in this situation values (50…60 % / 25…30 % / 10…25 %). It will be done by the decline of the share of expenses on the development of the UPT and PAT sector. Therefore, Russia will be forced to switch to a new paradigm of development of urban transport systems. Russia will repeat the

experience of the majority of European cities and some Asian cities that passed this journey 10…25 years ago [67], [68].

e. There is no doubt that Russia will not be able to avoid the worldwide trend of the growth of the sector of collaborative usage of individual mobility vehicles. But the results of the research show that even experts point out a serious resistance to the reorganization of structure and technologies of urban mobility provision in Russia.

f. Studies similar to those presented should be conducted regularly. Their goal is to monitor the current situation in the transport services market and promptly respond to all changes related to economic and social shifts in society.

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Author's Declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors readand approved the final manuscript.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

Additional information

No additional information from the authors.

References

[1] D. Alexandrov, "Production of passenger cars in Russia fell by 96.7 % [In Russian]," *Autonews*, Jun. 30, 2022. [Online]. Available: https://www.autonews.ru/news/62bd418a9a79476595785b44?ysclid=l5719cx841225882519

[2] Partnerkin, "Full list of companies that left Russia on July 1 - updated list [2022] [In Russian]," *f.partnerkin.com*, 2022. https://f.partnerkin.com/blog/allinfo/spisok_kompanii_kotorie_yshli?ysclid=l5gmtaiz57203889961 (accessed Jul. 04, 2022).

[3] M. Shipenkov, "The Russian car market is waiting for large-scale shocks [In Russian]," *vz.ru*, Jun. 11, 2022. [Online]. Available: https://vz.ru/economy/2022/6/11/1162560.html?ysclid=l5gmz3e2rd529019412

[4] V. Loboda, "The Russian car market in June 2022 [In Russian]," *autostat.ru*, 2022. https://www.autostat.ru/analytics/51981/?ysclid=l5gn2ahqgo22599432 (accessed Jul. 06, 2022).

[5] Ministry of Internal Affairs of the Russian Federation, "Indicators of the state of road safety [In Russian]," *State Autoinspection Traffic Police*, 2022. http://stat.gibdd.ru/ (accessed Jun. 25, 2022).

[6] Migration Portal, "Price increase in 2022 [In Russian]," *emigrating.ru*, 2022. https://emigrating.ru/10-07-2022-povyshenie-tsen-v-2022-godu/?ysclid=l5gn7pp8ut435857353 (accessed Jul. 10, 2022).

[7] Statbureau, "Inflation rate in the Russian Federation in 2022 [In Russian]," *statberau.org*, 2022. https://www.statbureau.org/ru/russia/inflation?ysclid=l5gndgbk9b775146370 (accessed Jul. 10, 2022).

[8] V. Protskova, "Rosstat has disclosed data on the population of Russia by the end of 2021 [In Russian]," *lenta.ru*, Jan. 29, 2022. [Online]. Available: https://lenta.ru/news/2022/01/29/russia/?ysclid=l5gnmc37t823964901

[9] A. Timerkhanov, "How many cars were there per 1000 inhabitants in the USSR? [In Russian]," *autostat.ru*, 2022. https://www.autostat.ru/infographics/46910/?ysclid=l5gnpeztil838752509 (accessed Jul.

10, 2022).
[10] города-россия, "Cities of Russia [In Russian]," *города-россия.рф*, 2022. https://города-россия.рф/alphabet.php (accessed Jul. 10, 2022).
[11] A. Klimnov, "Russian fleet at the beginning of 2021 – age and structure [In Russian]," *rim3.ru*, Mar. 19, 2021. [Online]. Available: https://rim3.ru/avtonovosti/analiz-rynka/rossiyskiy-avtopark-na-nachalo-2021-goda-vozrast-i-struktura/?ysclid=l594jbq3dw393612617
[12] V. Loboda, "Car park: what do Russians drive? [In Russian]," *autostat.ru*, 2021. https://www.autostat.ru/press-releases/47703/?ysclid=l5gny930970527384 (accessed Jul. 10, 2022).
[13] V. Pareto, "Cours d'économie politique, nouvelle édition par GH Bousquet et G," *Busino, Genève, Droz*, vol. 1, pp. 299–345, 1964.
[14] I. Vladimirsky, "Russian car market: results of 2021 [In Russian]," *autoreview*, 2022. https://autoreview.ru/news/rossiyskiy-avtorynok-itogi-2021-goda?ysclid=l570qjaq8p334059487 (accessed Jul. 10, 2022).
[15] P. A. Smelov *et al.*, "Women and men of Russia.2020: Statistical Collection," Moscow, Russia, 2021. [Online]. Available: https://rosstat.gov.ru/storage/mediabank/yhNtbedG/Wom-Man 2020.pdf
[16] Government of the Russian Federation, *Decree of the Government of the Russian Federation: On admission to driving vehicles*. Russia, 2014. [Online]. Available: https://base.garant.ru/70774562/?ysclid=l5gocupe6p902956720
[17] A. Ghanbari, O. Álvarez San-Jaime, T. Casey, and J. Markendahl, "Repositioning in value chain for smart city ecosystems: A viable strategy for historical telecom actors," in *2015 Regional Conference of the International Telecommunications Society (ITS)*, 2015.
[18] A. Burrows, J. Bradburn, and T. Cohen, *Journeys of the Future: Introducing Mobility as a Service*. London: Atkins Global, 2015.
[19] B. Atasoy, T. Ikeda, X. Song, and M. E. Ben-Akiva, "The concept and impact analysis of a flexible mobility on demand system," *Transp. Res. Part C Emerg. Technol.*, vol. 56, pp. 373–392, 2015, doi: 10.1016/j.trc.2015.04.009.
[20] J. Luk and P. Olszewski, "Integrated public transport in Singapore and Hong Kong," *Road Transp. Res.*, vol. 12, no. 4, p. 41, 2003.
[21] M. Finger, "Mobility-as-a-Service: from the Helsinki experiment to a European model?," *FSR Transport*. pp. 1–13, 2015. [Online]. Available: http://fsr.eui.eu/wp-content/uploads/150309-1-Finger-1.pdf
[22] E. Gould, W. Wehrmeyer, and M. Leach, "Transition pathways of e-mobility services," *WIT Trans. Ecol. Environ.*, vol. 194, no. 1, pp. 349–359, 2015.
[23] R. Giesecke, T. Surakka, and M. Hakonen, "Conceptualising mobility as a service," in *2016 eleventh international conference on Ecological Vehicles and Renewable Energies (EVER)*, 2016, pp. 1–11.
[24] P.-E. Holmberg, M. Collado, S. Sarasini, and M. Williander, "Mobility as a Service-MaaS: Describing the framework," in *Tuesday, February 16, 2016*, 2016.
[25] F. C. Nemtanu, I. M. Costea, and L. G. Obreja, "Model of intelligent traffic sensors—Application in hardware in the loop," in *2017 40th International Spring Seminar on Electronics Technology (ISSE)*, 2017, pp. 1–5. doi: 10.1109/ISSE.2017.8000957.
[26] S. Liyanage, H. Dia, R. Abduljabbar, and S. A. Bagloee, "Flexible mobility on-demand: An environmental scan," *Sustainability*, vol. 11, no. 5, p. 1262, 2019, doi: 10.3390/su11051262.
[27] M. J. Doherty, F. T. Sparrow, and K. C. Sinha, "Public use of autos: mobility enterprise project," *J. Transp. Eng.*, vol. 113, no. 1, pp. 84–94, 1987.
[28] T. P. Hughes, "The evolution of large technological systems," *Soc. Constr. Technol. Syst. New Dir. Sociol. Hist. Technol.*, pp. 45–76, 2012.
[29] F. W. Geels, "From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory," *Res. Policy*, vol. 33, no. 6–7, pp. 897–920, 2004.
[30] F. W. Geels, "The dynamics of transitions in socio-technical systems: a multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930)," *Technol. Anal. Strateg. Manag.*, vol. 17, no. 4, pp. 445–476, 2005.
[31] W. B. Arthur, "Competing technologies,

increasing returns, and lock-in by historical events," *Econ. J.*, vol. 99, no. 394, pp. 116–131, 1989.

[32] S. G. Winter and R. R. Nelson, "An evolutionary theory of economic change," *Univ. Illinois Urbana-Champaign's Acad. Entrep. Leadersh. Hist. Res. Ref. Entrep.*, 1982.

[33] R. A. Nelson, "Recent evolutionary theorizing about economic change," in *Theorien der Organisation*, Springer, 1997, pp. 81–123.

[34] W. Walker, "Entrapment in large technology systems: institutional commitment and power relations," *Res. Policy*, vol. 29, no. 7–8, pp. 833–846, 2000, doi: 10.1016/S0048-7333(00)00108-6.

[35] D. Leonard-Barton, "Core capabilities and core rigidities: A paradox in managing new product development," *Strateg. Manag. J.*, vol. 13, no. S1, pp. 111–125, 1992.

[36] M. L. Tushman and P. Anderson, "Technological discontinuities and organization environments. I: Pettigrew, A.(red.)," *Manag. Strateg. Chang.*, 1987.

[37] A. Grübler, *Technology and global change*. Cambridge: Cambridge university press, 2003.

[38] N. Nakicenovic, "The automobile road to technological change: diffusion of the automobile as a process of technological substitution," *Technol. Forecast. Soc. Change*, vol. 29, no. 4, pp. 309–340, 1986.

[39] R. Keivani, "A review of the main challenges to urban sustainability," *Int. J. Urban Sustain. Dev.*, vol. 1, no. 1–2, pp. 5–16, 2009.

[40] K. M. Davidson, J. Kellett, L. Wilson, and S. Pullen, "Assessing urban sustainability from a social democratic perspective: a thematic approach," *Local Environ.*, vol. 17, no. 1, pp. 57–73, 2012.

[41] R. F. M. Ameen, M. Mourshed, and H. Li, "A critical review of environmental assessment tools for sustainable urban design," *Environ. Impact Assess. Rev.*, vol. 55, pp. 110–125, 2015.

[42] H. AlWaer and R. D. Kirk, "Matching a community assessment tool to the requirements of practice," *Proc. Inst. Civ. Eng. Des. Plan.*, vol. 169, no. 5, pp. 216–229, 2016.

[43] V. Cappuyns, "Inclusion of social indicators in decision support tools for the selection of sustainable site remediation options," *J. Environ. Manage.*, vol. 184, pp. 45–56, 2016.

[44] Verified Market Research, "Mobility As A Service Market Size And Forecast," 2022. [Online]. Available: https://www.verifiedmarketresearch.com/product/mobility-as-a-service-market/

[45] Market Research Future, "Mobility as a Service Market," 2022. [Online]. Available: https://www.marketresearchfuture.com/reports/mobility-as-a-service-market-3109

[46] ICT Moscow, "The route is built: prospects for the development of MaaS in Moscow and other megacities of the world [In Russian]," *ict.moscow*, 2022. https://ict.moscow/news/maas-in-global/?ysclid=l5ihqrckzy612066451 (accessed Aug. 19, 2022).

[47] A. Petrov and D. Petrova, "Atmospheric pollution in cities of Russia: statistics, causes and characteristics," in *IOP Conference Series: Earth and Environmental Science*, 2017, vol. 72, no. 1, p. 12007.

[48] K. P. Gluschenko, "On the issue of application of the Gini coefficient and other inequality indices," *Vopr. Stat.*, no. 2, pp. 71–80, 2016.

[49] N. Zubarevich, "Inequality of regions and large cities of Russia: what was changed in the 2010s?," *Obs. Nauk. i Sovrem.*, no. 4, pp. 57–70, 2019.

[50] T. Petrova, A. Grunin, and A. Shakhbazyan, "Integral index of traffic planning: Case-study of moscow city's transportation system," *Sustainability*, vol. 12, no. 18, p. 7395, 2020.

[51] A. Petrov and S. Evtyukov, "Analysis of possibilities for achieving targets of Russian Road Safety Strategy," *Transp. Res. procedia*, vol. 50, pp. 518–527, 2020.

[52] A. I. Petrov, S. A. Evtyukov, V. I. Kolesov, and D. A. Petrova, "Informational-entropic analysis of dynamics of road safety orderliness," in *IOP Conference Series: Materials Science and Engineering*, 2019, vol. 582, no. 1, p. 12021.

[53] Urban Environment Quality Index, "The Urban Environment Quality Index is a tool for assessing the quality of the material urban environment and the conditions for its formation [In Russian]," *индекс-городов.рф*, 2022. https://индекс-городов.рф/#/

(accessed Sep. 01, 2022).

[54] Government of the Russian Federation, "Transport strategy of the Russian Federation until 2030 with a forecast for the period up to 2035 [In Russian]," *static.government.ru*, 2022. http://static.government.ru/media/files/7enYF2uL5kFZlOOpQhLl0nUT91RjCbeR.pdf (accessed Sep. 02, 2022).

[55] Russian Academy of Transport, "Transport strategy of the Russian Federation until 2035: toll roads and public-private partnership [In Russian]," *rosacademtrans.ru*, 2022. http://rosacademtrans.ru/tremdi_strategii/?ysclid=l5igpfigd1396112200 (accessed Sep. 04, 2022).

[56] A. Falewicz and W. Bak, "Private vs. public self-consciousness and self-discrepancies," *Curr. Issues Personal. Psychol.*, vol. 4, no. 1, pp. 58–64, 2016, doi: 10.5114/cipp.2016.55762.

[57] K. G. Kholodkovskii, "Complex problems of modern public consciousness," *Polis. Polit. Stud.*, vol. 3, no. 3, pp. 176–181, 2018, doi: 10.17976/jpps/2018.03.12.

[58] Yandex, "How much does use a personal car cost – Yandex Research [In Russian]," *yandex.ru*, 2020. https://yandex.ru/company/researches/2020/auto-cost?ysclid=l5ihe1r3wv796600843 (accessed Sep. 07, 2022).

[59] D. A. Hensher, "Future bus transport contracts under a mobility as a service (MaaS) regime in the digital age: Are they likely to change?," *Transp. Res. Part A Policy Pract.*, vol. 98, pp. 86–96, 2017.

[60] P. Pleul, "It became known how much Moscow will lose after the EU abandons Russian gas [In Russian]," *news.ru*, 2022. https://news.ru/economics/stalo-izvestno-skolko-moskva-poteryaet-posle-otkaza-es-ot-rossijskogo-gaza/ (accessed Sep. 08, 2022).

[61] Kapital Rus, "Russia's budget revenues have collapsed due to the gas war with Europe [In Russian]," *kapital-rus.ru*, 2022. https://kapital-rus.ru/news/389387-dohody_budjeta_rossii_ruhnuli_izza_gazovoi_voiny_s_evropoi/?ysclid=l6guvfzz4q875372350 (accessed Sep. 08, 2022).

[62] Government of the Russian Federation, "Explanatory note to the draft federal law «On federal budget for 2023 and for the planning period 2024 and 2025» [In Russian]," *minfin.ru*, 2022. https://www.minfin.ru/common/upload/library/2022/06/main/Maket_PZ_2023-2025_SBP_i_GRBS.pdf (accessed Sep. 08, 2022).

[63] K. Turoń and G. Sierpiński, "Bike-sharing as a possibility to support Vision Zero," in *MATEC Web of Conferences*, 2018, vol. 231, p. 3005.

[64] K. Turoń and A. Kubik, "Open Innovation—Opportunities or Nightmares for the Shared Transport Services Sector?," *J. Open Innov. Technol. Mark. Complex.*, vol. 8, no. 2, p. 101, 2022.

[65] Ride-Sharing Market, "Ride Sharing Market by Type (E-hailing, Station-Based, Car Sharing & Rental), Car Sharing (P2P, Corporate), Service (Navigation, Payment, Information), Micro-Mobility (Bicycle, Scooter), Vehicle Type, and Region - Global Forecast to 2026," 2022. Accessed: Sep. 11, 2022. [Online]. Available: https://www.marketsandmarkets.com/Market-Reports/mobility-on-demand-market-198699113.html

[66] R. Filippova and N. Buchoud, *A Handbook on Sustainable Urban Mobility and Spatial Planning: Promoting Active Mobility*, no. ECE/TRANS/298. 2020.

[67] M. Noussan, M. Hafner, S. Tagliapietra, M. Noussan, M. Hafner, and S. Tagliapietra, "The evolution of transport across world regions," *Futur. Transp. Between Digit. Decarbonization Trends, Strateg. Eff. Energy Consum.*, pp. 1–28, 2020, doi: 10.1007/978-3-030-37966-7_1.

[68] Y. Gao and J. Zhu, "Characteristics, Impacts and Trends of Urban Transportation," *Encyclopedia*, vol. 2, no. 2, pp. 1168–1182, 2022, doi: 10.3390/encyclopedia2020078.