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Global innovations as benchmark to improving efficiency on road transport in the Russian Federation . A case study of the city of Novosibirsk

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The article takes an overview of innovations in the road transport sector in some selected countries and makes recommendations for their implementation in the Russian Federation

Keywords: innovation methods, urban passenger transport system, environmental pollution.

The city of Novosibirsk is located in the center of Siberian region of the Russian Federation. It the third largest city after Moscow and St. Petersburg respectively, with over 1.6 million population. It remains one of the fastest growing cities in the world, for which it is documented in the Guinness Book of Records [1]. The urban passenger transport features a network of buses, trolleybuses, trams, taxicabs, shuttle taxicabs and a subway. All types of public passenger transport are equipped with electronic payment system. Being a fast growing city, volume of traffic is on the increase causing the menace of congestion and environmental pollution.

The need for effective mechanisms in the field of road transport directed at meeting the needs of consumers (passengers), as well as reducing environmental pollution in the face global warming is of paramount importance. It is becoming increasingly inevitably important to encourage the general populace to use public transport instead of the more wasteful option (private cars) stemming from continuous warnings by climate scientists. To achieve this feat there is the need to embrace consented efforts by government institutions, engineers, city planners, manufacturing concerns and all other stakeholders to come up with measures to make public transport have comparative urge over usage of private cars.

A study conducted by Anna Popova, the head of the Federal Service for Supervision of Consumer Rights Protection and Human Welfare, showed that previously the atmosphere was polluted mainly by manufacturing companies, but today up to 80% is accounted for by motor transport. The researcher attributed this to an increase in the number of cars in the cities of the Russian Federation [2].

Another research carried out by I.N. Pugacheva concluded that a one percentage transfer of passengers from public transport to private cars increases the intensity of traffic, and, consequently, the load on the road infrastructure by 10% [3].

At the Paris Climate Conference (COP21 in December 2015), participants from 195 countries adopted the world's first ever universal, legally binding agreement on global climate. The agreement sets out a plan of action to prevent dangerous climate change, which limits annual global warming to below 2 ° C. Following the agreement, most innovation tools and

regulations by most countries, especially in the road transport sector, are geared toward achieving this goal [4].

In order to solve the problems traffic congestion and environmental pollution, major cities around the world are redefining their means of transportation using various innovative tools, including simple reorganization, enactment of laws, introduction of high-tech devices, environmentally friendly vehicles, etc.

According to the Federal Environment Agency (UBA) of Germany, about 70 cities, including Munich, Stuttgart, Dusseldorf and Cologne, recorded an average level of nitrogen dioxide above the limit levels set by European Union standards in 2017. On February 27, 2018 one of the highest courts in Germany ruled that heavily polluting vehicles should be banned in the cities of Stuttgart and Dusseldorf. The decision followed a sue by some environmental activists in dozens of cities in Germany, claiming that various cities authorities are obliged to reduce air pollution to protect people's health. Stuttgart and Düsseldorf, two of the most polluted cities in Germany, could now by this court verdict, legally prohibit older, more polluting vehicles, paving the way for other cities to follow suit [5].

In recent past decades, countries accross the globe have introduced different innovation methods to combact global warming. Innovations in the road transport sector are mostly directed toward reducing greenhouse gas emission by vehucles on the hand and patronizing more environmentally friendly vehicles, such as public transport (instead of private ones), bicycles and others on the other hand.

It should be noted that the extent to which countries shift to more green technologies varies from country to country. Germany is one of the most advanced countries in this field. Germany brings a lot of experience to innovation in the transport sector and provides an extensive, efficient and attractive regional and city public transport network. Notable among these is extensive and efficacious network of cycle lanes. The country is also moving forward with solutions such as more energy efficient vehicles, alternative fuels, car-free pedestrian areas, extensive bicycle lanes, successful bicycle exchange programs, and smart ticket pricing solutions.

Germany has managed to improve its public transport system by reducing costs and increasing efficiency, while maintaining customer service as a top priority. Germany attributed these achievements mainly to recent innovations in the field of intelligent information technologies (IT): real-time information available to passengers at most stations and through electronic devices, bus tracking systems, software-optimizing solutions, and innovative applications for ticket sales.

Regarding tickets for passenger transport, there are various affordable and more convenient subscriptions, for example, a daily subscription, a weekly subscription and a monthly subscription. Also on weekends, a “Family Ticket” is sold - one ticket for four people, that is, for two adults, two children.

In cities such as Bremen, Berlin, Hamburg and Munich, more than 20 percent of the population uses public transport, more than 30 percent go walking, 10 percent uses a bicycle and less than 40 percent use sprivate cars.

For example, in the city of Bremen (Germany) in order to attract private car owners to public transport, priority of using roads is primarily given to public transport, and not to private cars. In this city, in places where priority of public transport transcends private motorists, there are devices installed in the traffic lights. Similar devices are also installed in the buses that interface (interact) with devices installed in the traffic lights. When the bus arrives at the traffic lights, these devices in the buses give a signal to the devices installed in the traffic lights, and when the traffic lights receive information from the buses, if at that time the red light is on, then after a few seconds (10-15 seconds) the traffic light switches to green light to let through the bus is faster; and where priority is given to pedestrians, the traffic lights have a button, when a pedestrian clicks on it, then after 10 - 15 seconds the traffic light switches to green light so that the pedestrian can pass through the road. Also, buses have the right to use the tram tracks, but private cars are prohibited.

Currently, the lifestyle of Americans is changing towards more ecological means of transport, especially in large cities. Americans are gradually abandoning the use of private cars in favor of public transport. More and more cities are supporting the introduction of public transport systems, extensive networks of cycle paths and recreational neighborhoods, all geared toward decreasing volume of traffic on the roads. Concurrently, a lot more cities use alternative fuel (environmentally friendly fuel) for their fleets, and passenger transport agencies are trying to improve their services. To deal with congestion problems and solve the problem of lack of infrastructure financing, the United States authorities are beginning to introduce toll roads. In addition, the introduction of IT components is becoming an intergral element in the road transport sector to improve service quality and ensure more efficient operation.

Regarding environmental pollution, the United States has used the most ecological fuel in the past decade - hydrogen fuel in car engines. Hydrogen has high energy, but the engine that burns pure hydrogen, virtually, does not pollute the environment. NASA has used liquid hydrogen since the 1970s to blast off space shuttle and other rockets into orbit. Hydrogen fuel cells power the shuttle's electrical systems, producing a clean by-product — clean water that the space crew drinks.

According to a study by the American Public Transport Association (APTA), as of January 1, 2014, 41.3% of the US public transport buses used alternative fuels or hybrid technologies. This is in contrast to 2.1% of cars using alternative fuels in 2013. APTA statistics for 2014 showed that 16.9% of public transport buses were hybrid-electric, 16.7% of buses used compressed natural gas or liquefied natural gas (LNG). Biodiesel accounted for 7.4% of public transport buses. Other alternative fuels, such as propane and hydrogen, were 0.3%. These ecological clean sources energy-efficient-transportation-systems are widely used in all US cities, including New York, San Diego, Orlando and others.

Despite the high achievement of the United States, most of the developments that are quite new to the United States have long been used in Germany with modern infrastructure system. Now other countries, especially decision makers in the field of transport, can benefit from this many years of experience of German organisations. For example, the activities of the German company GACC Midwest, a key intermediary in promoting transatlantic business cooperation, are aimed at developing an extensive and unique knowledge exchange between the USA and Germany, bringing together stakeholders in the transport sector and examining synergies for innovation and investment [6, 7, 8, 9, 10].

Bus Rapid Transit (BRT) system was opened in 2010 in Guangzhou, China. The system works productively, thereby revolutionizing the perception of passenger transportation in the China and Asia. The BRT system is allocated separate lanes for buses. It functions effectively, reducing the problem of traffic congestion and air pollution to the bearest minimum. Unlike railway projects, construction BRT lanes does not require state or legislative approval; the project is implemented at the local government level, that is, the decision is made much faster. BRT is also cheaper and faster to construct than projects of railways or subways. Designed to meet the needs of a large volume of transport in a fast-growing city, the system averages 850,000 passengers per day and makes the maximum throughput of about 28,000 passengers during rush-hour to one direction as of 2013, which is higher than most metro lines in the world. BRT is integrated with other modes of transport in the city and directly connects to the network subway systems. Guangzhou, the third largest city after Shanghai and Beijing, has a population of more than 10 million and continues to accommodate a large influx of rural migrants seeking job opportunities in big cities [11].

Lanzhou, a city in the northwestern region of the People's Republic of China, with a three million population, opened its Bus Rapid Transit system at the end of December 2012. Inspired by the BRT success of Guangzhou, Lanzhou built the country's second high-speed bus transit system, which carried 290,000 passengers a day. Initially, Lanzhou intended to build large roads and tunnels to improve road access. But, thanks to the intervention of key organizations, the infrastructure project has become a plan for high-quality public transport with modal integration

and urban development. Lanzhou authorities revived the city and made it more mobile, which satisfies high passenger traffic (instead of a large number of private cars). The BRT system developed includes the world's first concept of divided bus stops. Due to the adjustment to local spatial conditions and operational requirements, the road construction is only half the usual length and only about one meter extra in width, but at the same time, buses traveling in one direction stop on both sides of the platform. As a result, volume of passengers is high and travel time is very fast [12].

In addition to the above innovations, China is planning to introduce driverless vehicles in some selected cities. On December 18, 2017, the Beijing Municipal Transport Commission announced preliminary rules for checking driverless vehicles on city roads. Transport organizations registered could then apply for permission to test their cars on Beijing's busy roads. A committee composed of experts in the field of transport, telecommunications, automobiles, computer science and law will evaluate the road test activities.

Driverless vehicles can significantly improve traffic and environmental conditions. According to researches by the Boston Consulting Group (BCG), and the World Economic Forum, the widespread use of automated vehicles can reduce the number of cars in the streets by 60%, vehicle emissions by 80% and road accidents by 90%. [13,14]

Innovation activities in the UK are aimed at reducing gas emissions and traffic accidents. The technology developed and manufactured by Zeta Automotive under the name Econospeed in London works to limit the driver's ability to accelerate excessively, but provides full power when and where it is needed. This modern technology helps to reduce fuel consumption, cut costs and reduce carbon emissions. Econospeed also has the added advantage of limiting the ability of the driver to accelerate aggressively. This means that passengers are much more comfortable. The technology could be retrofitted into existing engines, which makes accessible for transport operators to upgrade their fleets.

Over the next five years, the British transport organization Arriva's, user of Econospeed technology, is planning to increase its fleets with Econospeed technology in some countries in Europe, including Sweden, Spain, Italy, Denmark, the Netherlands, Portugal, Croatia, Slovenia, the Czech Republic, Slovakia and Hungary.

It is estimated that a 2% reduction in fuel use will help Arriva's save up to approximately 4 million pounds per year in the UK, which will serve as an incentive to boost investment in the public transport sector.

In addition, Econospeed technology will help reduce carbon emissions. Earlier in 2016, British Prime Minister Theresa May promised to ratify the Paris Agreement by the end of 2016.

This means a 57% reduction in carbon emissions (relative to 1990 levels) by 2050. The bus industry plays a vital role in ensuring that the UK pursues these obligations [15].

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Table

Summary of some innovation activities in road transport from global experience

City	Country	Innovative tool / activity	Implementation of innovative tool in the Russian Federation (Road transport industry)
			Advantages / Comments
Bremen	Germany	- Installation of a network interface devices on traffic lights and on public transports.	- Quick access to public transport, satisfying the need of passengers. - Reduction of pollution by attracting private car drivers to public transport. - Reduction of traffic intensity. - Reduction of wear and tear of road infrastructure. - Incentive to private investors to the passenger transportation industry.
Bremen	Germany	- Regulatory legal act giving right only to public transport to use tram roads (tracks).	- Quick passage for public transport (efficient travel time).
Bremen	Germany	- Different subscriptions (daily, weekly, monthly, family on weekends)	- Convenience for buyers.
New York	U.S.A.	- Introduction of hydrogen fuel.	- Reduction of pollution.
Guangzhou	China	- Seperate lanes for buses.	- Operational in Russia.
Lanzhou	China	- Two parallel platforms at one bus stop.	- Quick passage for public transport (efficient travel time). - Reduction of traffic intensity (jam).
Beijing	China	- Driverless cars	- Improvement of traffic and environmental conditions. - Reduction of road accidents.
London	U.K.	- Installation "Econospeed" device regulating the speed of the driver.	- Improvement of traffic and environmental conditions. - Reduction of road accidents. - Fuel economy.

The foregone explanation indicates the importance of transforming the modus operandi of service provision in the road transport

sector in major cities of the Russian Federation. These transformations would make it imperative to introduce innovative technologies in the industry in order to increase competitiveness, increase the attractiveness of public transport for the populace and increase efficiency of organizations (transport operators) providing public transport services.

Having analyzed innovation activities in public transport in the road sector from the global perspective and the state of passenger transportation by road in the city of Novosibirsk, we recommend the following innovations:

- Installation of a network interfaced devices on traffic lights and on public transports. The current technology for installing traffic lights in the city of Novosibirsk does not give priority to public transport. When established the interface between public transport and traffic lights, public transport will be much more time efficient, which will make it comfortable for passengers and attractive to private investors;
- introduction of different subscriptions (daily, weekly, monthly) for the convenience of buyers;
- retrofitting public vehicles with the Econospeed device in order to save fuel, reduce carbon dioxide emissions and regulate the speed of drivers, which in turn will reduce road accidents.

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