

A systemic approach to road safety in the EU

Un enfoque sistémico de la seguridad vial en la Unión Europea

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Vladimir Ivanovich Mayorov 

Krasnodar University of the Ministry of Internal Affairs of Russia. Krasnodar (Russia)
mayorov_vladimir@outlook.com

Viktor Vasilievich Denisenko 

Krasnodar University of the Ministry of Internal Affairs of Russia. Krasnodar (Russia)
viktor.vas.denisenko@yandex.ru

Sergey Gennadievich Solovev 

South Ural State University (National Research University). Chelyabinsk (Russia)
sergey.g.solovev@mail.ru

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Abstract

The article considers the main directions for implementing the Road Safety Strategy for 2021-2030 adopted by the European Union (hereinafter referred to as the EU Road Safety Policy). It reveals targets and indicators of this Strategy and dwells on the Safe System approach to road safety, which is the basis of the EU Road Safety Policy. The Safe System is based on such concepts as Vision Zero and Sustainable Safety and influences the main elements of the road traffic system (vehicles, road network, road users) to ensure the safety of transportation. The comparative analysis of the EU Road Safety Policy and the Russian Road Safety Strategy for 2018-2024 has demonstrated similar directions in their implementation. However, the European document is characterized by a greater consistency and scientific validity of the measures being developed with due regard to the latest trends in the field of road traffic. The Road Safety Strategy adopted in Russia traditionally considers the violation of traffic rules by vehicle drivers.

Keywords: Road safety; social risk; road traffic accident; road infrastructure; vehicle safety

Resumen

El artículo está dedicado al análisis de las principales áreas de implementación de la Estrategia para la seguridad vial para 2021-2030 adoptada en el territorio de la Unión Europea (en adelante, la Estrategia SV de la UE). Se examinan los objetivos y los indicadores de esta Estrategia, se revela el contenido del enfoque de seguridad vial Safe System, que es la base de la Estrategia Europea. Safe System se basa en los principios de las concepciones Vision Zero y Sustainable Safety y tiene como objetivo influir en los principales elementos del sistema de tráfico (vehículos, red de carreteras, usuarios de carretera) para garantizar la seguridad del proceso de transporte. El análisis comparativo de la Estrategia SV de la Unión Europea y la Estrategia SV de Rusia para 2018-2024 mostró la similitud de las principales esferas de aplicación, pero el documento europeo se caracteriza por una mayor sistematización y validez científica de las medidas que se están desarrollando, por tener en cuenta las últimas tendencias en materia de tráfico, mientras que la Estrategia SV adoptada en Rusia tradicionalmente considera la violación de las Normas de tráfico por los conductores de vehículos como la principal causa de los accidentes de tráfico.

Palabras clave: Seguridad vial; riesgo social; accidentes de tránsito; infraestructura vial; seguridad del vehículo

INTRODUCTION

The issues of ensuring road safety and reducing the level of deaths and injuries in road traffic accidents are recognized by the entire world community ([Artemenko et al., 2021](#); [Gu et al., 2021](#); [Xu et al., 2022](#)). According to the World Health Report of 2018, for children and young people between the ages of 5 and 29, road traffic injuries represent the leading cause of death, with the total number of road traffic deaths reaching 1.35 million people each year (World Health Organization-[WHO, 2018](#)). Within the framework of state policies, both developed and developing countries work on comprehensive measures to reduce the number of road accidents and minimize their negative consequences.

The European Union-EU implemented the EU Road Safety Policy Framework 2021-2030 —Next steps towards “Vision Zero” in 2021, which sets the goal of reducing road traffic fatalities and serious injuries by 50% by 2030 (European Commission-[EC, 2019](#)).

The European experience in the field of road safety is of particular interest for Russia since the EU countries have the lowest indicators of social and transport risk in the world. At the strategic level, Russia aims at reducing deaths in road accidents by three times by 2024 (if compared to 2016), which necessitates the search for new, more effective methods and approaches to ensuring road safety.

The purpose of this research is to study a systemic approach to road safety in the EU, modern approaches of the EU countries in the field of road safety in the framework of the implementation of the EU Road Safety Policy Framework for 2021-2030, and the Vision Zero concept.

The novelty of the study lies in the comparison of European and Russian experience in ensuring road safety, including the approaches used to reduce the level of road traffic injuries.

The structure of the article is determined by the study goal and includes an introduction, which briefly presents the relevance, purpose, and novelty of the study, a literature review, a research methodology, a discussion, a conclusion, and a list of references.

LITERATURE REVIEW

The past decade of 2011-2020 was declared by the United Nations-UN as a “Decade of Action for Road Safety” with the global goal of stabilizing and reducing the projected death rate from road traffic accidents around the world by expanding the relevant activities at the national, regional, and global levels. Supporting this initiative, the EU expected that road traffic deaths would have reduced by half by 2020 (by 50%) if compared to 2010 (EC, 2010). However, statistics show that the expected results were not achieved despite quite positive general trends: between 2001 and 2010, the number of road deaths in the EU decreased by 43%, and in the period from 2010 to 2019 it declined by another 23%.

Considering the dynamics of road traffic deaths, some EU countries were able to achieve a significant decrease in mortality, while others slightly changed their indicators. Eight countries (Germany, Greece, Latvia, Luxembourg, Finland, France, Croatia, and Sweden), had the best indicators: most of them managed to reduce the number of road traffic deaths by at least 30%-35%. As the most successful country, Greece was able to achieve a reduction of 45%, almost reaching the initial target. The result obtained is conditioned by the effectiveness of national target programs in the field of road safety (Maiorov & Sevryugin, 2015).

The level of social risk, which is understood as the ratio of deaths in road accidents per 100,000 population (Figure 1), was 5.1 in the EU in 2019. At the same time, the safest roads are in Sweden (2.2) and Ireland (2.9), while Romania (9.6), Bulgaria (9), and Poland (7.7) entered the top three outsiders in terms of social risk (European Road Safety Observatory-ERSO, 2020). In Russia, this indicator was 11.7 in 2019 (Ministry of Internal Affairs of the Russian Federation-MVD, 2021), which is far from the goal of reducing social risk to four deaths per 100 000 people by 2030 approved at the strategic level.

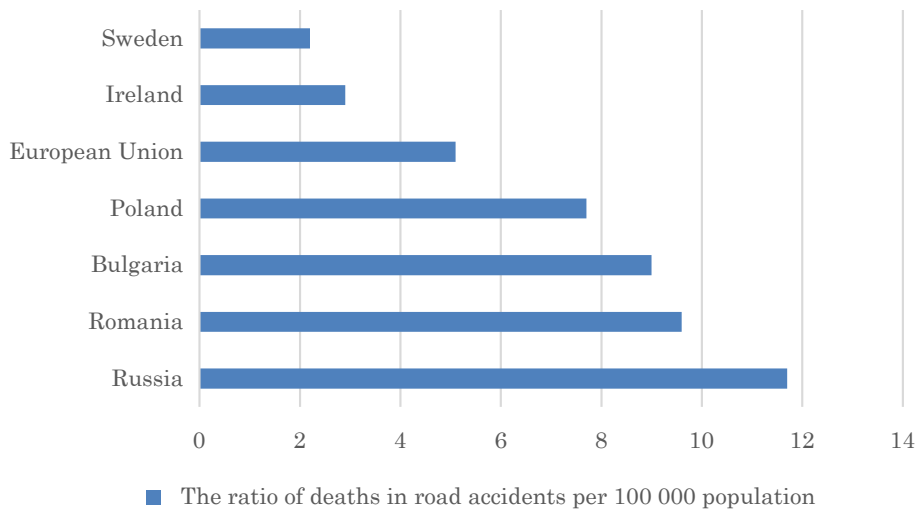


Figure 1. The ratio of deaths in road accidents in 2019

Source: ERSO (2020), MVD (2021).

The new EU Road Safety Policy 2021-2030 sets before the EU member states both the traditional goal of reducing the traffic-related death rate by 50% (which was declared in the EU program documents in the previous two decades [EC, Directorate-General for Energy and Transport-Eurostat, 2004], but had been never fully achieved) and highlights the need to reduce the number of serious injuries in road accidents. This was largely influenced by the *Valletta Declaration on Road Safety* of March 29, 2017; this document establishes that “the work on improving road safety should not be measured only by counting road deaths; the number of serious injuries is no less worrying as it is five times higher than the number of road deaths” (EU, 2017, p. 2). In this regard, a target has been set to halve road traffic injuries by 2030 if compared to 2020.

In the long term, the EU Commission’s road safety action plan should result in zero deaths on the EU roads by 2050 (within the Vision Zero concept). Such an ambitious goal requires the most effective methods and means to achieve it. According to the EU Road Safety Policy 2021-2030, the EU should adopt a new approach (the Safe System) in the field of road traffic.

This approach is based on such EU strategies as Vision Zero and Sustainable Safety. Initially, it was formed and implemented in Australia and New Zealand ([Turner et al., 2010](#)).

Vision Zero is a well-known road safety strategy that was first introduced in Sweden in 1997. The strategy is based on an underlying ethical principle that it can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system. The concept emphasizes the inadmissibility of treating such accidents as the necessary evil of motorization.

The main idea of Vision Zero is “the imperfect human being” (“to err is human”), therefore, the responsibility for road safety is primarily assigned to the designers and builders of road transport infrastructure who should consider the human factor and minimize the likelihood of an accident using construction and planning decisions, measures for traffic organization, etc. Currently, similar strategies have been adopted by many European countries, as well as in certain cities in the USA and Canada.

Sustainable Safety was developed in the Netherlands and also focuses on measures to improve road transport infrastructure and, subsequently, improve road safety. The strategy aims at “preventing unsafe traffic conditions” ([Schermers & Van Vliet, 2001](#), p. 8) through:

1. Forming mono-functional roads and subdividing all the roads into three types: highways, approach roads, and public roads in residential areas, each of which performs its function (highways ensure that traffic flows smoothly, without passing through residential areas);
2. Ensuring uniform speed and uniform motion on roads (especially highways), i.e. the separation of traffic flows;
3. Building a road environment that meets the expectations of road users (without any unexpected changes on roads);
4. Creating road infrastructure that prevents road accidents or reduces the severity of their consequences (“forgiving roads”) ([Pechatnova & Kuznetsov, 2019](#)).

The Safe System embraces the best features of these strategies and influences the main elements of the road traffic system, including vehicles, road networks, and road users.

Like Vision Zero, the Safe System recognizes that road users make mistakes and this cannot be avoided but injury and death in road accidents due to these errors can be prevented thanks to a multi-tiered combination of measures and more “forgiving” traffic systems.

For example, such measures are as follows: improving the design of vehicles, building better road infrastructure, and tightening speed limits, which can reduce the consequences of accidents. “Taken together, they should form layers of protection that ensure that, if one element fails, the other compensates for it to prevent the worst outcome” (EC, 2019).

METHODOLOGY

The main information sources were legal acts, official documents, and reports prepared during the implementation of the decades of action to ensure road safety (2011-2020, 2021-2030) by international organizations, as well as scientific articles related to world experience in road safety management and road traffic injury control. These sources contain strategic approaches to road safety management, recommendations, and measures to reduce road traffic injuries.

The best world practices developed at the global and regional levels can be partially or completely adapted for use in road safety activities in the preparation of strategic documents at the national level.

DISCUSSION

The content of the Safe System approach

The basic elements of Safe System in the EU Road Safety Policy are as follows:

1. *Safe roads*. The specifics of road infrastructure are a factor that can significantly affect the dynamics of accidents: either increase the number of road accidents ([Elvik et al., 2009](#)), or reduce it. Within the framework of the Safe System, priority is given to the formation of “compensating” roads that minimize the consequences of errors made by road users and resulting accidents (for example, flow splitters exclude the possibility of getting into the opposite lane).

As noted in the Global Status Report on Road Safety, launched by [WHO \(2015\)](#):

The use of infrastructure treatments to help manage speed and reduce the likelihood of a crash (for example through widening of the road, or raised pedestrian crossings), and treatments to mitigate the severity of the crash infrastructural (for example, using roadside barriers and roundabouts) all contribute to less death and injury on the road (p. 52).

In the EU, a permanent assessment of road safety is carried out based on the Directive of the [European Parliament-EP and of the Council of the European Union 2008/96/EC, 2008](#) on road infrastructure safety management. Accordingly, road network safety ratings are formed to determine high-risk road sections. In relation to the existing road network, it is recommended to classify road sections with the highest number of accidents and highways. To rank the former, the number of accidents is calculated taking into account traffic intensity or, in the case of an intersection, only the number of accidents. To rank the latter, they should be divided into categories and ranked depending on the number of accidents, traffic intensity, and type. Later sections are highlighted where it is necessary to implement measures to improve road conditions, for example: to improve visibility under different weather and light conditions, to enhance the adhesion/roughness of road surfaces, to implement traffic management and control systems, etc. The main provisions of this directive are recommended for both operated and projected networks ([Directive 2008/96/EC of the EP and of the Council, 2008](#)).

Under the EU Road Safety Policy, it is planned to develop a special map for the Trans-European road network by the end of 2024 that will showcase high accident concentration sections and the safety rating of all roads. Roads with the worst performance will be subject to targeted safety measures.

2. *Safe vehicles.* Over the past decades, the safety of vehicles used in the EU has significantly increased. Currently, the safety requirements for vehicles and their components are governed by [Regulation \(EC\) No 661/2009 of the EP and of the Council](#). This document is regularly improved, with its latest edition of 2019 providing new safety features (including Intelligent Speed Assistance, Emergency Lane Keeping Assist, the “direct vision” requirements for buses and trucks, etc.). These measures should prevent the death of 7 300 people in road accidents and save 38 900 people from serious road traffic injuries across the EU by 2030.

In addition to complying with legal requirements, car manufacturers are encouraged to further improve their vehicle safety, including through the use of mechanisms for the consumer assessment of new cars (the best-known system is the European New Car Assessment Program (Euro NCAP)).

Within the framework of the [Euro NCAP \(2021\)](#), crash tests are developed and implemented to create a voluntary vehicle safety rating system. In a nutshell, these tests simulate real-life accidents that could result in the serious injury or death of the driver and passengers. The result is also influenced by the safety equipment offered by the manufacturer for each market. Based on the test results, the car is assigned from one to five stars, where one star means the lowest level of crash protection and no collision avoidance system, while five stars stand for a high level of crash protection in all spheres and excellent equipment with reliable collision avoidance systems. A large number of stars demonstrates not only a good test result but also the availability of safety equipment on the tested model for all European consumers ([Euro NCAP, 2021](#)).

The EU Road Safety Policy recognizes the Euro NCAP safety assessment, supported by studies that show that the risk of death and serious injuries for road users driving a five-star vehicle is 68% and 23% less than for those driving a two-star car.

3. *The safe behavior of road users*, including compliance with speed limits, drug and alcohol prohibition, the use of protective equipment, and avoiding distraction. The human factor traditionally plays a key role in ensuring road safety. The EU Road Safety Policy notes that general education and awareness are not effective enough, but such measures as driver licensing, targeted education, and user awareness, backed up by sustainable road safety regimes, are essential to ensure road safety (EC, 2019).

The issues of establishing responsibility for the violations of established traffic rules are within the competence of national legislators. However, the above-mentioned European policy emphasizes the danger of each violation and their contribution to the statistics of deaths and accidents on European roads. The state members are encouraged to develop comprehensive measures for their prevention.

4. *Post-crash care*. The relevant studies demonstrate that about 50% of road traffic deaths occur within minutes at the scene or en route (before a victim is transported to the hospital). If a patient is admitted to the hospital, 15% of deaths occur within the first four hours after an accident, and 35% die in more than four hours (EC, 2018b).

Post-crash care or injury treatment refers to the initial medical assistance provided at the scene of a road accident, during transportation to a medical center, or afterward. Effective post-crash care, including fast transportation by qualified personnel to the correct facility, reduces the consequences of any injury. The EU Road Safety Policy states that reducing the ambulance time of arrival from 25 to 15 minutes after an accident can reduce mortality by 30% (Sánchez-Mangas et al., 2010), while the comprehensive training of rescue and ambulance teams can reduce the time to evacuate victims of truck and car accidents by 40%-50% (EC, 2018b).

One of the tools to increase efficiency in this area is *eCall*, namely the European system for automatic notification of road accidents installed on vehicles. When special sensors detect the fact of an accident, eCall automatically establishes a connection with the European emergency number 112 and transmits data on the location of the crashed vehicle and other information about the accident (EC, 2022).

Currently, the installation of eCall is mandatory for all new passenger cars, but the EC considers a possible extension of this system to other categories of vehicles (heavy vehicles, buses, motorcycles, etc.).

Similar emergency response systems exist in the United States, Brazil, China, Russia, etc. In China, the collision avoidance system is part of the *BeiDou* Satellite Navigation System which also performs other functions in the field of road safety and traffic management (Syuy, 2020). In Russia, the ERA-GLONASS system (its mechanism is similar to eCall) is pre-installed on all new vehicles.

In general, the European version of the Safe System practically does not differ from the original version implemented in Australia (Turner et al., 2010). One of the main principles that ensure the effectiveness of the Safe System is the mutual responsibility of road users, government agencies, and other actors directly or indirectly ensuring road safety.

It is worth mentioning that the Safe System is consistent with modern concepts of sustainable transport (sustainable mobility), including a set of transport policies focused on the sustainable development of cities and towns, for example, in terms of the use of measures to organize road traffic and improve its safety (Komarov & Akimova, 2021).

In addition to the general Safe System directions in the EU Road Safety Policy for 2021-2030 (EC, 2019), it dwells on the following measures:

- a. To shape public opinion about the intolerance of road traffic deaths and injuries;

- b. To improve the efficiency of cross-border control of traffic violations based on [Directive \(EU\) 2015/413 of the EP and of the Council](#), facilitating cross-border exchange of information on road-safety-related traffic offenses;
- c. To increase coordination between promoters of road safety, within certain countries and the entire EU;
- d. To develop new ways to assist the EU Member States with the worst road safety performance.

We should also consider the development of organizational and legal foundations for the automation of vehicle control in developed countries. To improve road safety, unmanned vehicles aim at eliminating the human factor, i.e. the mistakes of car drivers that can cause road accidents. In some countries, autonomous vehicles have been seen on public roads for several years, mainly in test mode or as the so-called “robotaxi” available to common users (USA, China). For the longest time, the study and development of unmanned vehicles have been the most active in the United States. However, in terms of their introduction, the global leader is China which has planned to create a basis for the wide and full use of unmanned vehicles by 2025 ([Xu, 2021](#)).

The introduction of self-driving vehicles is being discussed at both national and international levels due to the need to amend the Vienna Convention on Road Traffic (Economic and Social Council-[Ecosoc, 1968](#)). This document imposes on the driver the obligation to “be always able to drive their vehicle” and “to avoid any actions not related to driving” ([Ecosoc, 1968](#), p. 1), that should extend to the use of unmanned vehicles.

Automated vehicle control is defined as a direction of the third package of proposals to the Europe on the Move project ([EC, 2018a](#)). The EU Road Safety Policy emphasizes the great potential of unmanned vehicles to reduce road accidents and the emergence of new issues in their use, including in the field of cybersecurity and interaction with traditional vehicles and other road users. In this regard, the EC sets the task of developing strategic and regulatory documents for the implementation of road automation and intelligent transport systems.

After assessing the EU Road Safety Policy, we can conclude that it correlates with modern trends in the field of road traffic safety and scientific developments. According to the [WHO \(2011\)](#), its provisions comply with the most effective measures to improve road safety, including urban planning and transport planning; designing safer roads and establishing independent road safety audit guidelines for new construction projects; improving vehicle safety elements; enacting and enforcing internationally harmonized laws requiring the use of seat belts, helmets, and child restraints; enhancing post-crash medical care for road traffic victims, etc.

Comparing the experience of Europe and Russia in ensuring road safety

While comparing the EU Road Safety Policy and the Russian state policy in the field of road safety, we have revealed their partial similarity and correspondence.

The Road Safety Strategy for 2018-2024, adopted in the Russian Federation-RF ([MVD, 2021](#)), which is the basis for the formation and implementation of policy in the area under consideration, highlights the following spheres of road safety:

1. To change the behavior of road users to unconditionally comply with road traffic rules and regulations;
2. To better protect the most vulnerable road users, especially children and pedestrians, from road accidents and their consequences;
3. To improve the existing road network in conformity with road safety conditions, including the development of road traffic organization;
4. To form organizational and legal mechanisms for allowing vehicles and their drivers onto public roads;
5. To enhance the system of road safety management;
6. To develop a rescue assistance system for road traffic victims ([Order of the Government of the RF, 2018](#)).

In one form or another, these spheres are reflected in the EU Road Safety Policy. However, their comprehensive study, including the tasks set within each area, shows that the driver is still considered the main culprit of road accidents in Russia. In this regard, most measures under development are directed toward drivers and are predominantly repressive.

This approach is characterized by excessive limitations and has been criticized more than once by administrative scientists ([Rosinskii, 2013](#)). We believe that road safety depends on “the state of law and order, the development of motorization, the quality of human interaction with technology, the improvement of roads and settlements, road traffic organization” ([Maiorov, 2009](#), p. 46), and many other factors. Therefore, their comprehensive analysis is of particular importance.

Within the Russian Road Safety Strategy ([MVD, 2021](#)), the measures directed not at road users are rather fragmentary and declarative. Thus, the improvement of road safety management is limited to improving coordination between its actors and updating the regulatory legal framework. The responsibility of public authorities for road safety is still not established, despite the priority of state responsibility for ensuring road safety over the responsibility of road users enshrined in [Federal Law No. 196-Fz of the RF \(1995\)](#) “on Traffic Safety”.

The measures improving organizational and legal mechanisms for allowing vehicles and their drivers on public roads are developed primarily for drivers. In relation to vehicles, public authorities only tighten laws in the field of technical vehicle inspection. On the one hand, this approach is quite justified since the number of accidents caused by technical malfunctions is constantly growing. On the other hand, the need to improve the overall safety of vehicles is neglected.

It is known that most Russian cars, in terms of their active and passive safety features, are inferior to foreign ones, while the issues of increasing their safety are not considered within the framework of road traffic policies ([Gordeeva & Lyakhov, 2022](#)).

In Russia, there is the ARCAP (Autoreview Car Assessment Program) similar to the Euro NCAP project. It conducts an independent assessment of both Russian and foreign vehicle safety, which can increase consumer awareness and improve the active and passive safety of Russian cars.

The Road Safety Strategy of the Russian Federation provides measures in relation to road infrastructure but mostly focuses on road traffic organization. [Federal Law No. 443-FZ of the RF \(2017\)](#) “on the Organization of Road Traffic in the Russian Federation and on Amendments to Certain Legislative Acts of the Russian Federation” defines road traffic organization as “activities to regulate the movement of vehicles and/or pedestrians on public roads aimed at reducing the loss of time (delays) during such movement, provided that road safety is ensured” ([Federal Law of the RF No. 443-FZ, 2017](#)). Consequently, road traffic organization is an independent activity, for which road safety is only a condition for implementation and its main goal is to reduce the loss of time during transport movement. To ensure road safety, it is necessary to consider road activities, transport, and urban planning, where road safety is a secondary task.

The National Project “Safe High-Quality Roads” aims at improving road traffic safety. Its main objectives are to reduce the number of road accidents and align roads in the largest urban areas to a standard. At the same time, this project is criticized for the lack of an integrated approach, when safety and comfort requirements are not always met, as well as the weak coordination of actions among various departments and structures aimed at achieving common goals in the field of road facilities and road safety ([Voroshilov, 2020](#)).

The information obtained within the framework of this study should become the basis for the next steps toward the goals of the Second Decade of Action for Road Safety and the national project Safe Quality Roads ([Bakanov et al., 2022](#); [Gordeeva & Lyakhov, 2022](#)).

CONCLUSIONS

Being a long-term action plan, the EU Road Safety Policy contains a set of measures to improve road safety. It is based on a scientifically grounded approach that considers the impact of all road traffic subsystems on the accident rate.

The key differences between the European and Russian policies in this field consist in the shift in emphasis from road users as the main culprits of road accidents to bodies and agencies responsible for maintaining and managing road traffic subsystems, increasing their responsibility and interest in reducing deaths and serious injuries as a result of road accidents.

The practical significance of the study is the opportunity for adapting the analyzed approaches to road safety (in particular, the Vision Zero approach) in strategic documents at the national level.

We concluded that although not all areas of the EU Road Safety Policy are relevant for Russia, most of them, as well as the principles and concepts of the Safe System, have significant prospects for improving road safety in Russia.

A detailed analysis of the components of the road safety system, as well as the threats and factors that stimulate the growth of road traffic accidents, will identify existing problems and outline ways to solve them. Further research in this area will allow tracking of the progress made both at the global level as a whole and by individual countries, in particular, in reducing the level of road traffic injuries as part of the implementation of the Second Decade of Action for Road Safety 2021-2030.

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Vladimir Ivanovich Mayorov. Doctor of Law. Professor of the Department of Constitutional and Administrative Law, Krasnodar University of the Ministry of Internal Affairs of Russia, Krasnodar, Russia. ORCID: <https://orcid.org/0000-0002-6490-3546>

Viktor Vasilievich Denisenko. Doctor of Law. Professor of the Department of Constitutional and Administrative Law, Krasnodar University of the Ministry of Internal Affairs of Russia, Krasnodar, Russia. ORCID: <https://orcid.org/0000-0003-4704-0774>

Sergey Gennadievich Solovev. Doctor of Law. Head of the Department of Social and Humanitarian and Legal disciplines. Professor of the Department of Theory of State and Law, Constitutional and Administrative Law, South Ural State University (National Research University), Chelyabinsk, Russia. ORCID: <https://orcid.org/0000-0001-9314-8538>