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Road Safety Concept in the Republic of Belarus

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Abstract. The general trend of accident rate reduction, which has been observed in the Republic of Belarus since 2010, reversed in 2017–2018. Remaining within the framework of the country's traditional engineering activities related to road maintenance is unlikely to significantly improve road safety. A transition to qualitatively new practices and mechanisms for ensuring road safety is required. In order to implement this transition, a second Road Safety Concept has been developed. The Concept is based on the Safe System approach, which offers the implementation of measures in four areas: improving road infrastructure safety, increasing vehicle safety, ensuring safe speeds, and training safe road users. The main threat to the implementation of the Safe System approach in the Republic of Belarus is the fixation of stakeholders on their narrow corporate interests and the unwillingness to take into account nation-wide road safety. The Concept mainly focuses on the "Safe Road Infrastructure" component. A transition to sustainable road safety and the introduction of a Forgiving Road approach are included in the Concept. The introduction of assessment of infrastructure projects impact on traffic safety, traffic safety audit and inspections, road traffic risk assessment, and elimination of accident hotspots are also specified. The introduction of road safety audit is considered an important milestone in the transition to the Forgiving Road approach. The development of Intelligent Transportation Systems is included for the same purpose. Despite the fact that the Concept sets reasonably realistic goals, there are certain concerns about the feasibility of their achievement. This is due to significant institutional problems, such as the lack of a single coordinating body and the complexity of interdepartmental interaction.

Keywords: road safety in Belarus, Safe System; Safe Road Infrastructure, Forgiving Road, safe speeds

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Концепция безопасности дорожного движения в Республике Беларусь

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Реферат. Общая тенденция снижения аварийности, наблюдавшаяся в Республике Беларусь с 2010 г., в 2017–2018 гг. сменилась на обратную. Оставаясь в рамках традиционной для страны инженерной деятельности, связанной с содержанием дорог, вряд ли удастся существенно повысить безопасность дорожного движения. Необходим переход к качественно новым практикам и механизмам обеспечения безопасности дорожного движения. Для осуществления этого перехода была разработана вторая Концепция безопасности дорожного движения. Концепция базируется на системном подходе к «безопасности», который предлагает реализацию мероприятий по четырем направлениям: повышение безопасности дорожной инфраструктуры, повышение безопасности транспортных средств, обеспечение безопасных скоростей и обучение безопасных участников дорожного движения. Основной угрозой реализации системного подхода безопасности в Республике Беларусь является заикленность заинтересованных сторон на своих узкокорпоративных интересах и нежелание учитывать общегосударственную безопасность дорожного движения. Основное

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внимание в Концепции уделяется компоненту «Безопасная дорожная инфраструктура». В Концепцию включены переход к устойчивой безопасности дорожного движения и внедрение подхода «дорога, которая прощает». Также предусмотрено внедрение оценки влияния инфраструктурных проектов на безопасность движения, аудита и проверок безопасности движения, оценки рисков дорожно-транспортных происшествий, ликвидации очагов аварийности. Внедрение аудита безопасности дорожного движения считается важной вехой в переходе к подходу «дорога, которая прощает». С той же целью включена разработка интеллектуальных транспортных систем. Несмотря на то что в Концепции поставлены достаточно реалистичные цели, существуют определенные опасения по поводу возможности их достижения. Это связано со значительными институциональными проблемами, такими как отсутствие единого координирующего органа и сложность межведомственного взаимодействия.

Ключевые слова: безопасность дорожного движения в Республике Беларусь, безопасная система, безопасная дорожная инфраструктура, прощающая дорога, безопасные скорости

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Introduction

The improvement of road safety, which is aimed at preserving the life, health, and property of the public, is one of the national policy priorities of the Republic of Belarus and an important factor in ensuring the country's sustainable development.

Road traffic is marked by increased hazards and includes the following main threats:

- physical and property threats, which include traffic accidents leading to the death and injury of people, damage to vehicles, cargo, road structures, and other property;

- environmental threats, which include environmental pollution by motor vehicles, increased noise levels, and other factors that are harmful to human health, to the state and society;

- social threats, which include deliberate violation of the legislation by road users, their aggressive and inadequate behavior on the roads, public dissatisfaction with the state of the roads and traffic management;

- economic threats, which include unjustified stops and excess mileage of vehicles, excessive fuel consumption of vehicles, and delays of road users on the road.

A fairly large number of traffic accident deaths as well as the lack of positive downward trends of this number, set against an increase in the number of vehicles in the early 2000s, contributed to the adoption by the government of the first Road Safety Concept in the Republic of Belarus in 2006 [1].

The implementation of measures from the first Concept led to positive results: thus a constant decrease in the number of traffic accidents, traffic deaths and injuries was noted in the country.

The situation with traffic accidents has been improving in the Republic of Belarus since 2010. The total number of traffic accidents has decreased by a factor of 1.8, the number of deaths has decreased by a factor of 2, the number of injuries has decreased by a factor of 1.8. The number of child deaths has decreased by a factor of 2.8, and the number of injured children has decreased by a factor of 1.8. A downward trend has been noted in almost all types of traffic accidents. The most steadily decreasing types of accidents were collisions with animal-drawn transport, accidents involving a vehicle and a pedestrian, head-on collisions, and rollover accidents. At the same time, an insignificant overall growth has been noted starting from 2010 for such type of traffic accidents as “Other Accidents”.

The three most common types of traffic accidents in 2020 were accidents involving a vehicle and a pedestrian, collisions at road intersections or at road turns, and rollover accidents.

Meanwhile, the trend changed in 2017–2018, and the indicators show deterioration. An increase in the total number of traffic accidents, deaths, and injuries has been registered, as well as an increase in certain types of traffic accidents and their prevailing causes.

Since 2017, there has been a constant increase in such traffic accidents as rollover accidents and collisions with cyclists. The most significant increase has been noted for such traffic accidents as animal collisions: from 3 to 41 cases since 2017. An increase in other 4 types of traffic accidents has been noted since 2018.

The main types of traffic accidents in the Republic of Belarus are collisions with pedestrians,

rollover accidents, vehicle collisions, including collisions at road intersections and road turns, and collisions with cyclists. In total, they account for more than 70 percent of all accidents and injuries.

More than 80 percent of traffic accidents in the Republic of Belarus occur through the fault of vehicle drivers, and the number of such accidents is increasing. The prevalent reasons for these accidents are violating the rules for driving through pedestrian crossings, driving while intoxicated, non-observance of priority, and speeding. Such accidents account for almost 50 % of all cases.

About 56 % of traffic accidents in the Republic of Belarus are registered within cities and towns. For 10 years, 55 % of all injuries were sustained during these accidents. The number of fatalities is significantly higher on highways, accounting for 72 % of all deaths between 2010 and 2020. At the same time, accident rates have been deteriorating both on highways and within towns starting from 2017–2018.

The number of vehicles has increased by a factor of 1.1 since 2010, amounting to 3.72 million vehicles. Thus, the transport risk indicator in the Republic of Belarus is 154.4 deaths per million vehicles. According to this indicator, the situation in the Republic of Belarus is better than in Russia, but worse than in Western Europe. Compared to countries such as the United Kingdom, Sweden, or Norway, the situation is 3.2–5.6 times worse.

Traffic injuries remain one of the most pressing concerns for the Republic of Belarus, which require intensified efforts of the state and the public in influencing the key accident factors that affect the number of fatalities in traffic accidents. The lack of attention to this problem can lead to a more noticeable increase in the main accident rates in the coming years.

The analysis of the experience of economically developed countries shows that traffic accidents can and should be prevented, and if an accident nevertheless does occur, then its negative impact on the life and health of the public must be reduced as much as possible [2].

Thus, it is required to reinforce the systemic work on the implementation of relevant measures, to develop and implement new approaches in priority activities, taking into account the current situation in the considered area and the existing resource constraints.

As of January 1, 2021, there are 86 technical standards in place in the Republic of Belarus that are directly related to road safety. However, these standards barely contain any requirements for the road infrastructure safety management processes. For this reason, no effective action is being taken in this area.

Due to the lack of real road infrastructure safety management in the Republic of Belarus, the accident rates, which had tended to decline, began to grow in 2017–2018 (Fig. 1). In general, this fact corresponds to the global experience of countries' adaptation to the conditions of growing motorization of the population, and at the same time confirms that after reaching a certain level of motorization, traditional road safety practices become ineffective and the introduction of fundamentally different approaches is required [3].

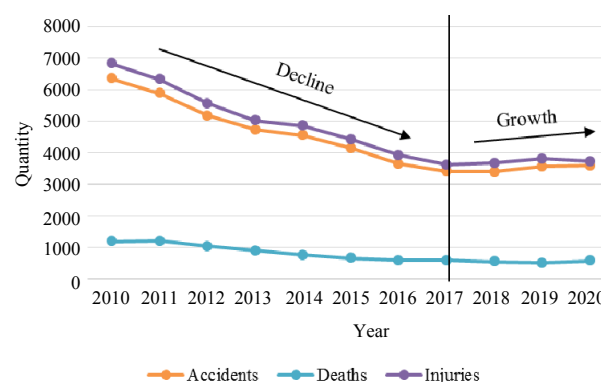


Fig. 1. Change in accident rates in the Republic of Belarus

This situation led the transport industry executives of the Republic of Belarus to initiate the development of the second Road Safety Concept.

Concept Development Methodology

After analyzing the experience of other countries, the Concept developers made a decision to use the Safe System approach. Safe System notably includes the coordinated implementation of measures in four areas: improving road infrastructure safety, increasing vehicle safety, ensuring safe speeds, and training safe road users [4]. The Safe System principles are widely known and have been described many times in different publications [5, 6]. The Safe System approach was also promoted in Belarus by the World Bank. However, the problem in the Republic of Belarus is that the principles of this system do not find

the necessary response among the public, either at the level of ethics or at the level of practical actions.

The work of the transportation sector, law enforcement and health authorities directly affects the risks and consequences of traffic accidents.

The activities of the parties interested in arranging and improving road safety in the Republic of Belarus are currently not coordinated properly. No single national operator of the road safety system exists, which results in no single systemic policy being developed in this area. Traffic management has no control structure either. Its functions are dispersed among many departments and organizations that are not responsible for the quality of road traffic. At the same time, international experience shows that without solving these issues, the country has little chance of implementing successful measures to achieve road safety and the desired results [3].

The most significant problem is the fixation of the parties concerned on their narrow corporate interests and the unwillingness to consider nationwide road safety. When it comes to road safety issues, the reasoning of a considerable part of decision-makers has halted at the level of the first half of the 20th century [7].

Effective management of the results of road safety requires systematic and planned response measures, as well as improvement of the overall road safety management system. Based on international experience, road safety should be considered as a production process where the primary role is assigned to institutional management functions that ensure the implementation of effective system-wide measures for achieving results designated as long-term goals and short-term quantitative indicators [8].

The primary long-term goal of the Concept is to create prerequisites for achieving such a state of road traffic in the future in which no people are killed or injured as a result of traffic accidents in the Republic of Belarus.

The short-term goals of the Concept are:

- reducing the number of traffic accidents with injuries, not exceeding 3050 cases per year by 2025, and 2850 cases by 2030;
- restoration of the downward trend of accident rate statistical indicators that took place in 2010–2017.

The concept is designed for the period till 2030. This does not mean that all problems will be solved and the Safe System approach will be fully implemented by 2030. It is expected that the basic prerequisites will be created and the active implementation of the Safe System approach will begin during this period. The achievement of targets will be assessed every 5 years and corrective actions will be taken, if necessary. If the Concept goals for each component are successfully achieved, the Concept can be extended with the establishment of new targets.

Safe Road Infrastructure. The second Concept mainly focuses on improving road infrastructure safety. A safe road infrastructure minimizes traffic accident potential through road design and road usage [9].

The Concept makes provisions for a range of works on determining the key performance indicator called “percentage of length of roads with a safety rating above the established limit”. This indicator can be based on the determination of the rating according to the IRAP methodology and has more of a probable value, since such research is not done in Belarus.

The Concept includes the following areas of improving road infrastructure safety for highways (Fig. 2).

During investment feasibility studies, the impact of infrastructure projects on road safety is assessed. Any changes within a new infrastructure project or changes to the existing infrastructure that significantly affect traffic on the road network are subject to assessment.

The goal of transitioning towards sustainable road network safety is to prevent traffic accidents and minimize their consequences. Infrastructure designed and built on sustainable safety principles maximizes the separation of vehicles with large differences in direction, speed, and mass on the roads and contributes to the safe behavior of road users.

Sustainable road network safety assumes that prevention is better than mitigation of consequences, and is based on the following principles [10]:

- road functionality;
- uniformity of mass and/or speed and direction;
- recognition and predictability of roads and user behavior;
- physical and social forgiveness;
- awareness of the condition.

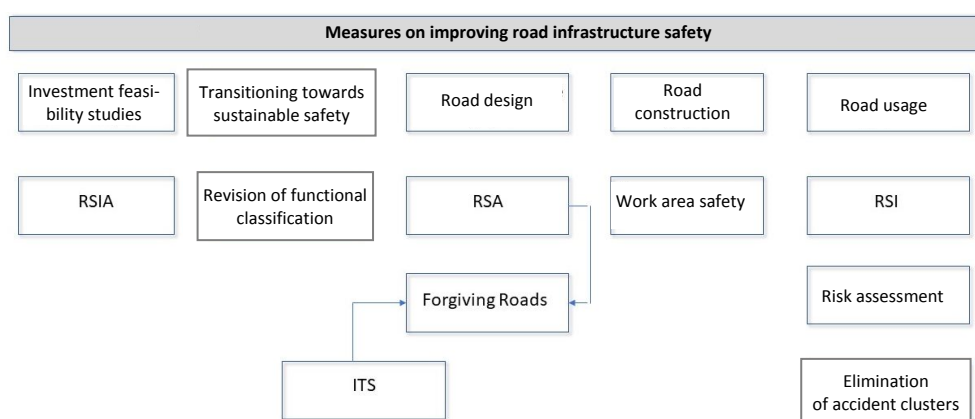


Fig. 2. Areas of improving road infrastructure safety included in the Concept

Roads should be mono-functional. This means that each road must perform only its own function. In accordance with the road mono-functionality approach, roads are classified as local, distribution, and through roads. However, the road network in the Republic of Belarus has been formed a long time ago, and the mono-functionality principle is not observed in almost all cases. Moreover, road owners and road authorities show no interest in eliminating multi-functionality. For this reason, the implementation of the principle is one of the most difficult tasks.

The Concept includes the following main measures at the road design stage:

- introduction of the Forgiven Road approach into the design [11];
- introduction of road safety audit.

The Concept includes implementation of the following measures within the Forgiven Road approach:

- introduction of road design in the Republic of Belarus with the number of lanes “2+1”;
- multi-stage pedestrian crossings. On highways with two carriageways, only multi-stage pedestrian crossings are used;
- road interchanges. On highways with two carriageways which perform through road functions, a gradual reconstruction of all one-level intersections to multi-level intersections is included;
- expanding the use of traffic barriers, including front barriers, revision of the usage rules for traffic barriers;
- using horizontal road marking with noise bands;
- pedestrian refuge islands are used at pedestrian crossings both on highways with one carriageway and within towns;

- reconstruction of intersections (roundabouts, channeling, arrangement of acceleration and deceleration lanes). On highways with one carriageway, a gradual reconstruction of all one-level intersections is included using technical solutions that improve road safety, primarily the arrangement of roundabouts;

- artificial lighting. The use of artificial lighting is expanded on sections of highways outside of towns, and the standards for carriageway illumination are revised, primarily in hazardous areas;

- improving traffic management at the locations of roadside service facilities;

- the length of pedestrian footpaths is increased, primarily in areas with heavy pedestrian traffic outside of towns; designing structurally designated bikeways, primarily within towns;

- development of technical standards which take into account the needs of unprotected road users.

The purpose of road safety audit is to identify potential road safety problems that may affect any road user, and to propose measures for eliminating or mitigating these problems. An additional challenge for road safety audit in the Republic of Belarus is identifying the main road safety problems associated with road design in order to facilitate the transition to the Forgiven Road approach. Currently, road safety audit is recognized as an effective procedure in all developed countries. However, the implementation of this audit in the Republic of Belarus faces severe financial constraints. Moreover, the term “audit” is not allowed to be used in relation to road safety, instead experts have to use the euphemism “inspection of the road safety system”.

An additional line of action included in the second Concept, but not related to the Safe System approach, is expanding the use of Intelligent Transport Systems. ITS solutions allow meeting the requirements of the Forgiving Road concept

in a more cost-effective way. This is especially true for roads designed and constructed using old USSR standards. Reconstructing these roads in accordance with the requirements of the Forgiving Road concept is an expensive endeavor. ITS solutions can diminish and in some cases even eliminate the existing shortcomings of the old design and construction. The best results are achieved by combining ITS and the Forgiving Road concept.

At the stage of road construction, reconstruction, and repair, the main focus is given to the safe performance of road works in order to improve road safety. The Concept includes the revision of existing approaches to the fencing of road works, taking into account the best international practices and the introduction of risk management and planning in order to ensure safety.

At the stage of road usage, the following measures are implemented:

- inspection of road safety;
- road traffic risk assessment;
- identification and elimination of traffic accident clusters.

The inspection of road safety is an independent and formal assessment of the road in use in order to identify potential road safety problems that may affect any road user, and to propose measures for eliminating or mitigating these problems. As with road safety audit, the term “inspection” is also not allowed to be used in Belarus in relation to road safety. This term has to be replaced with “survey of the road safety system at the stage of road usage.”

The Concept includes the revision of existing approaches to identifying traffic accident clusters, taking into account the best international practices [11, 12].

Safe Speeds. The effect of high speeds on road safety has been well studied [13, 14]. Some studies show that the risk of an accident when speeding is 12.8 times higher than in case of complying with the established speed [15]. Speeding remains one of the most common causes of traffic accidents in the Republic of Belarus. The percentage of accidents caused by speeding has been 10–12 % annu-

ally since 2014. The downward trend in the number of accidents caused by speeding, which started in 2010, has slowed down after 2018 (Fig. 3).

The long-term goal of the Concept in terms of traffic speeds is to create prerequisites for achieving such a state of road traffic in the future in which no people are killed or injured as a result of traffic accidents caused by speeding in the Republic of Belarus.

The short-term goal of the Concept is to reduce the percentage of traffic accidents caused by speeding with injuries, not exceeding 7.5 % per year by 2025, and not exceeding 4.5 % per year by 2030. In 2020, this indicator was 10.5 %.

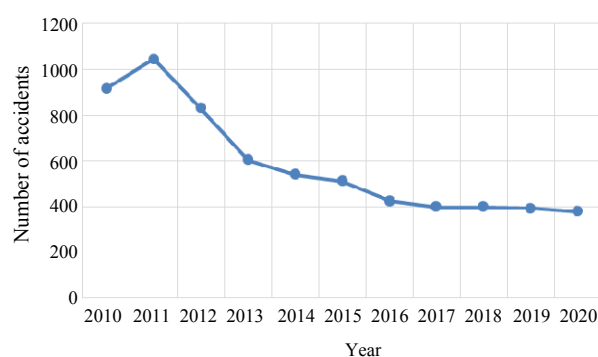


Fig. 3. Change in the number of accidents caused by speeding with fatalities and injuries

In order to introduce measures for optimizing and controlling speed limits, the following is included:

- continuous analysis of speed limits on republican highways according to the data of automatic sensors;
- installation of traffic speed sensors on local roads with a large number of traffic accidents;
- implementation of the traffic speed measurement system and the installation of traffic speed sensors within towns;
- development of a technical standard regulating speed limit control.

The efficiency of speed limit control is defined by the percentage of vehicles not exceeding speed limits in the total traffic flow that is determined by the measurements results of speed sensors.

In order to reduce the number of conflict situations in road traffic, prevent traffic accidents, and reduce the severity of their consequences, the new Concept introduces traffic calming methods aimed at changing speed limits.

For effective control over the observance of speed limits, the following is included:

- implementation of the average traffic speed measuring method on road sections. this method is planned to be introduced on at least 5 % of the length of national roads by 2030;

- expanding the practice of applying the average traffic speed measuring method on sections of city streets, primarily in Minsk and regional centers.

Currently, public awareness does not include the necessity to comply with speed limits. A long-term public awareness campaign on safe speeds is envisioned, promoting at least the following views:

- actual and potential risks on the road are not always obvious or identifiable;

- the driver's decisions about the chosen driving speed are usually made without considering the impact on the safety of other drivers;

- the driver is not always able to correctly judge the capabilities of the vehicle at high speeds (for example, the braking distance) and thus cannot choose the correct speed depending on the geometric features of the road and roadside conditions;

- the driver often lacks understanding of the impact of speed on the probability of an accident and the severity of its consequences;

- more uniform traffic speed has major advantages.

The effectiveness of the campaign is assessed annually by conducting an opinion poll of users on their attitude to speed limits.

Safe Vehicles. The technical level and technical condition of vehicles is one of the main factors determining road safety. Sudden breakdowns of vehicles involved in road traffic are usually accompanied by the most severe consequences.

The Concept includes the development of measures related to vehicle safety aimed at improving the safety and quality of transport in general. The aim of the Concept is to use safe vehicles in road traffic, and to monitor the technical condition of vehicles and the compliance with safety requirements.

The safety of commercial vehicles requires special attention.

Along with the implementation of various well-known legislative initiatives on the introduction of safety features into vehicles, the Concept includes the introduction of innovative technical devices for

improving the active and passive safety of vehicles, including driver assistance systems, such as forward collision warning systems, and the introduction of other smart technologies in order to ensure the free exchange of data and information between vehicles, as well as between vehicles and the road infrastructure, and the deployment of an automatic accident notification system.

The concept stipulates that the Safe Car ideology is implemented in the Republic of Belarus, which is based on the need to compensate for human imperfections by means of modern tools for active and passive vehicle safety, using multipurpose information and communication systems and mobile devices. These include systems and tools that are capable of the following:

- providing automatic braking and forced speed limitation in case of danger, preventing collisions with obstacles;

- monitoring compliance with road marking requirements, tracking blind spots;

- self-parking in confined spaces;

- warning the driver about fatigue and loss of concentration, responding to voice commands, etc.

The following is included:

- development of mechanisms to facilitate the purchase of safe vehicles by legal entities and individuals, refusal to use old, less safe vehicles that are not equipped with modern active and passive safety systems

- incentives for the purchase of safer vehicles, including electric vehicles, can be achieved by reducing the tax burden (subsidies, lower tolls for road use and parking, reduced rates for electricity when charging vehicles with an electric drive, and other incentives).

In order to increase the efficiency of control over the technical condition and design of vehicles, the following is included:

- analysis of current vehicle safety standards in the Republic of Belarus.

- revision of technical standards that stipulate the requirements for the technical condition of vehicles and its compliance with the specified safety requirements.

- strengthening control over the technical condition of vehicles during the entire period of their operation.

- development of measures aimed at ensuring that vehicles which have received mechanical

damage in accidents are subject to repair in the amount necessary in order to return them to road traffic in a fully operational condition;

– creation of mobile stations for checking the technical condition of vehicles by 2025.

Safe Users. The training of road users is critical for ensuring road safety. This training is aimed at road users acquiring the skills of driving safely on the streets and roads and consciously avoiding actions that pose a danger to other road users and that disrupt road traffic.

During their training, safe users acquire the knowledge and skills that ensure the proper behavior and safety of themselves and other road users in various traffic situations. Appropriate training programs are developed and systematic awareness building is carried out for this purpose, including in the media, on the Internet, social networks, etc.

The general areas of action for the training of safe road users are the following:

– development and revision of methods and programs for teaching the behavior culture on the roads and for ensuring road safety, at all education levels;

– holding information campaigns to form a negative attitude towards violations of traffic rules, and campaigns to form positive stereotypes of safe behavior on the streets and roads;

– introduction of speed limits for cyclists when using sidewalks and footpaths;

– setting a ban and responsibility for the use of personal mobility means by pedestrians in a state of intoxication;

– enhancing the liability of road users and responsible individuals for violation of the road traffic rules.

The Concept includes psychological training of traffic police officers in order to improve the quality of interaction with road users, as well as the need to equip traffic police patrol cars with first aid equipment and CPR devices (defibrillators), and to teach the rules for their usage.

Analysis and Results

Currently, the Concept has been fully developed, and after finalizing the approval processes with the interested parties, the Concept will be approved at the government level. An important achievement of the development is the fact that

it was possible to persuade the decision-makers in the Republic of Belarus that a qualitative change in approaches to road safety is necessary. As a result of this, the Concept encompasses modern international experience, such as Safe System, Forgiving Road, the transition to sustainable safety of the road network. Measures for road infrastructure safety management are included, such as assessment of impact on road safety, road safety audit, road safety inspection, and risk assessment. Judging by the experience of other countries [16], it can be argued that these measures alone are capable of having a significant effect. In addition, numerous measures are planned for improving the safety of vehicles and training safe users of the road network.

The Concept includes rather flexible primary goals. However, a regular analysis of the achievement of goals and their adjustment, if necessary, is stipulated. It is assumed that the Concept, which is initially designed for the period till 2030, will later be extended taking into account the achieved results.

Discussion

The Republic of Belarus has already developed a second Road Safety Concept. The measures of the first Concept were generally completed and produced good results. Will the goals of the second Concept be achieved? It is reasonable to assume that it will be much more difficult. The measures of the first Concept were aimed primarily at the implementation of infrastructure solutions and were carried out mainly by organizations that are subordinate to one ministry. Right now the question is about management decisions. These decisions require a change in the existing approaches and are related to the formation of interdepartmental communications. The procedure for financing various types of work also requires a change.

CONCLUSIONS

The Republic of Belarus has developed a second Road Safety Concept. The main difference of the second Concept is that it is based on the Safe System approach, which is currently the most effective concept adopted in many countries worldwide. Safe System includes the coordinated

implementation of measures in four areas: improving road infrastructure safety, increasing vehicle safety, ensuring safe speeds, and training safe road users.

The main differences of the new version of the Concept relate to the improvement of road infrastructure safety. In this regard, the transition to sustainable safety of the road network is stipulated, in accordance with which the main focus will be on the implementation of preventive measures in terms of road safety, which will reduce the cost of eliminating the consequences of traffic accidents. Practical application of road design according to the Forging Road approach is included. It is planned to develop Intelligent Transport Systems as an additional tool for ensuring road safety.

The implementation of measures for road infrastructure safety management is also included, such as assessment of the impact of projects on road safety, road safety audit and inspection, and road traffic risk assessment.

REFERENCES

1. Kapsky D., Bogdanovich S., Volynets A. (2020) Implementation of the Road Traffic Safety Concept in Belarus. Varhelyi, A., Žuraulis, V., Prentkovskis, O. (eds). *Vision Zero for Sustainable Road Safety in Baltic Sea Region. VISZERO 2018. Lecture Notes in Intelligent Transportation and Infrastructure*. Springer, Cham., 110–119. https://doi.org/10.1007/978-3-030-22375-5_13.
2. Johansson R. (2009) Vision Zero – Implementing a Policy for Traffic Safety. *Safety Science*, 47 (6), 826–831. <https://doi.org/10.1016/j.ssci.2008.10.023>.
3. Bliss T., Breen J. (2009) *Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country Guidelines for the Conduct of Road Safety Capacity Reviews and the Related Specification of Lead Agency Reforms, Investment Strategies and Safety Projects*. Available at: <https://www.aprso.org/sites/default/files/document/2020-07/country-guidelines-conduct-road-safety-management.pdf> (accessed 04 August 2022).
4. Austroads (2015) *Improving the Performance of Safe System Infrastructure. Research Report AP-R498-15*. Available at: https://www.researchgate.net/profile/Chris-Jurewicz/publication/295072998_Improving_the_Performance_of_Safe_System_Infrastructure/links/56c6e91208ae8cf828fba7a/Improving-the-Performance-of-Safe-System-Infrastructure.pdf (accessed 13 March 2018).
5. Turner B. (2013) *Implementing the Safe System Approach to Road Safety: Some Examples of Infrastructure Related Approaches*. Available at: <https://www.diva-portal.org/smash/get/diva2:760022/FULLTEXT01.pdf> (accessed 04 August 2022).
6. McTiernan D., Turner B., Wernham R., Gregory R. (2010) *Local Government and the Safe System Approach to Road Safety*. Vermont South: ARRB Group Ltd.
7. Kapskii D. V., Blinkin M. Ya., Tsygankov A. A., Sushko A. A., Bakhanovich, A. G., Kuzmenko V. I., Erchak O. V., Frishchin B. V. (2017) *Road Safety: Development Paradigms*. Minsk, Kapital Print Publ. 264 (in Russian).
8. Varhelyi A. (2016) Road Safety Management – The Need for a Systematic Approach. *The Open Transportation Journal*, 10 (1), 137–155. <https://doi.org/10.2174/1874447801610010137>.
9. SWOV (October 2007). *Background of the five Sustainable Safety Principles. SWOV Fact sheet*. Leidschendam, The Netherlands. Available at: https://d3n8a8pro7vhmxc.cloudfront.net/20splentyforus/legacy_url/298/FS_Sustainable_Safety_background.pdf?1431368025.
10. Wegman F., Aarts L., Bax Sh. (eds.) (2008) Advancing Sustainable Safety: National Road Safety Outlook for 2005–2020. *Safety Science*, 46 (2), 323–343. <https://doi.org/10.1016/j.ssci.2007.06.013>.
11. La Torre F., Saleh P., Cesolini, E., Goyat Y. (2012) Improving Roadside Design to Forgive Human Errors. *Procedia – Social and Behavioral Sciences*, 53, 235–244. <https://doi.org/10.1016/j.sbspro.2012.09.876>.
12. Elvik R. (2007) *State-of-The-Art Approaches to Road Accident Black Spot Management and Safety Analysis of Road Networks. Report 882/2007*. Available at: <https://www.toi.no/getfile.php?mmfileid=9022> (accessed 04 August 2022).
13. Geurts K., Wets G. (2003) *Black Spot Analysis Methods: Literature Review*. Available at: <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1090.8472&rep=rep1&type=pdf> (accessed 04 August 2022).
14. Richards D. C. (2010) *Relationship Between Speed and Risk of Fatal Injury: Pedestrians and Car Occupants. Road Safety Web Publication No 16*. Department for Transport, London, UK. Available at: https://nacto.org/docs/usdg/relationship_between_speed_risk_fatal_injury_pedestrians_and_car_occupants_richards.pdf (accessed 04 August 2022).
15. Rosen E., Sander U. (2009) Pedestrian Fatality Risk as a Function of Car Impact Speed. *Accident Analysis & Prevention*, 41 (3), 536–542. <https://doi.org/10.1016/j.aap.2009.02.002>.
16. Dingus T. A., Guo F., Lee S., Antin J.F., Perez M., Buchanan-King M., Hankey J. (2016) Driver Crash Risk Factors and Prevalence Evaluation Using Naturalistic Driving data. *Proceedings of the National Academy of Sciences of the United States of America*, 113 (10), 2636–2641. <https://doi.org/10.1073/pnas.1513271111>.

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