
Innovative Approaches in Assessing Social and Economic Damage from Road Accidents

V.P. Bychkov¹, M.V. Drapalyuk², I.Yu. Proskurina³, E.N. Busarin⁴

Abstract:

The article is devoted to the review of approaches and analysis of methods for assessing the cost of social and economic damage from road accidents. The urgency of the problem is determined by the high rates of accidents and deaths. Social and economic consequences of non-underestimation of human life in the country can negatively affect the individual quality of life of Russians, and state level in the form of damage from losses of the economically active population and the state's compensation for damages to the families of victims. Therefore, the development of new theoretical approaches to assess social and economic damage from accidents, which meet modern conditions, has become of particular relevance in Russia.

The article considers methodological peculiarities of accounting and assessment of the consequences of road accidents both within the framework of international experience and within the framework of the Russian Federation, which has allowed developing scientifically grounded approach to assessing damage from road accidents in our country, this in its turn contributes to reducing mortality rates through development and financial support of road safety programs.

Based on the author's research, an innovative approach to assessing social and economic losses from road accidents in the Russian Federation has been formed, which focuses on damage resulting from death and injury of people, taking into account age and gender structure of the deceased, wounded people and regional characteristics, damage as a result of damage to vehicles and goods, damage as a result of damage to roads and road structures, as well as moral damage.

Keywords: Road accidents, assessment of social and economic damage, innovative approaches, methodologies for assessing social and economic damage from road accidents.

JEL Classification Codes: G 28, G32, G31, G38, H70.

¹Corresponding author, Voronezh State University of Forestry and Technologies named after G.F. Morozov, Voronezh, e-mail: kafedra@vglta.vrn.ru

²Voronezh State University of Forestry and Technologies named after G.F. Morozov, Voronezh.

³Voronezh State University of Forestry and Technologies named after G.F. Morozov, Voronezh.

⁴Voronezh State University of Forestry and Technologies named after G.F. Morozov, Voronezh.

1. Introduction

Rapid increase in the number of road transport in recent years and massive inclusion of new drivers and carriers in the traffic have led to a significant change in characteristics and complexity of traffic conditions; increased traffic density, increased intensity and speed, which affected the state of crush rate. Crush rate in road transport is one of the most acute social and economic problem, which has acquired transnational character. It is not accidental that the United Nations Organization characterizes the state of road safety as a global crisis. Therefore, unification of efforts in this direction is required from the entire international community.

Road safety is one of the important social, economic and demographic tasks of the Russian Federation. Accident in road transport causes enormous material and moral damage to society as a whole and to individual citizens. Road traffic injuries lead to the exclusion of people of working age from the sphere of production. Children die or become disabled (Verzilin, 2009).

In Russia every 30 minutes one person dies in road accidents, and on average 25 thousand people die per year, which is equivalent to the population of a town. Great numbers of people get injuries of varying severity. It is necessary to improve road safety to reduce road deaths, which means that large government investments are needed. To determine the amount of these investments and to justify it, it is necessary to know the amount of social losses associated with death, disability and injuries as a result of an accident (Potseluev, 2012).

Thus, social and economic losses from road accidents are direct threats to the economic security of the Russian Federation. This urgently requires a revision of the state approach to the assessment of losses from road accidents, the high importance of which directly determines its relationship with the development of the Russian economy, as the experts' assessments and the analysis show a close relationship between road accidents and the economy (that is, the relationship between the accident rate and the state of the country's economy) (Kaziakhmedov, 2015).

2. Methods

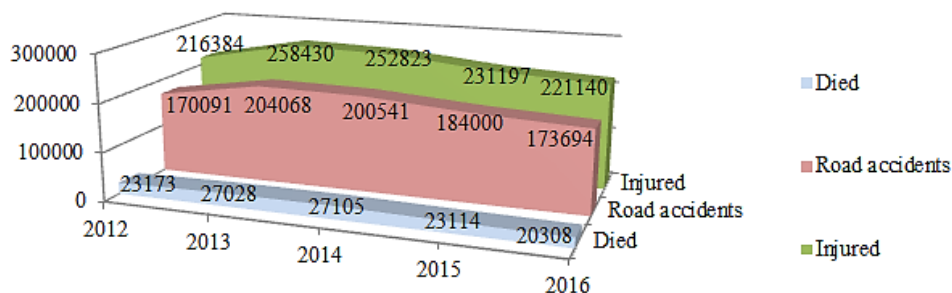
The analysis of the accident rate in the territory of the Russian Federation has been performed within the framework of the study. Information on road accidents is provided through the fault of drivers of transport belonging to legal entities and individuals, as well as with the participation of freight and passenger transport. Generalization method by summarizing and grouping data has been used to process the received information. The research used methods of comparison and observation for:

- analysis of the state of crash rate in the territory of the Russian Federation;
- consideration of methodologies for assessing social and economic damage from road accidents;
- desk research, including development of innovative approaches to assessing social and economic damage from road accidents.

3. Results

Over the past three years, the Russian Federation has been continuing a steady trend of reducing the main accident rates. At the end of 2016, there were 173.694 road accidents in the territory of the Russian Federation, in which 20.308 people were killed and 221.140 received injuries of varying severity. The total number of accidents has decreased by 5.6%, the number of dead people by 12.1% and the number of wounded people by 4.3% (Figure 1).

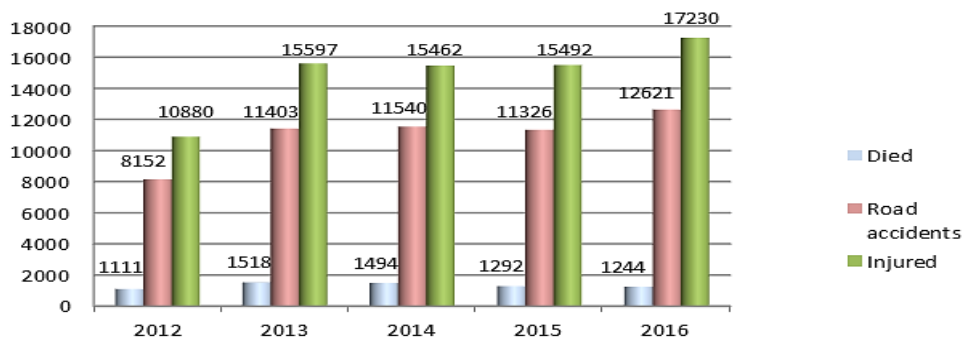
Figure 1. Main crash rates in the territory of the Russian Federation



On average, the country's fatal injuries in road accidents were each 12 of the victims, the severity of the consequences was 8.4. The severity of the consequences has decreased from 9.1 to 8.4 per 100 victims (dead and wounded). Against the background of the general decrease, the growth in accident rates which are attributed to the fault of drivers of transport belonging to legal entities is seen. The number of accidents increased by 11.4% (12.621) and wounded by 11.2% (17.230), while the number of deaths decreased by 3.7% (1.244) (Figure 2).

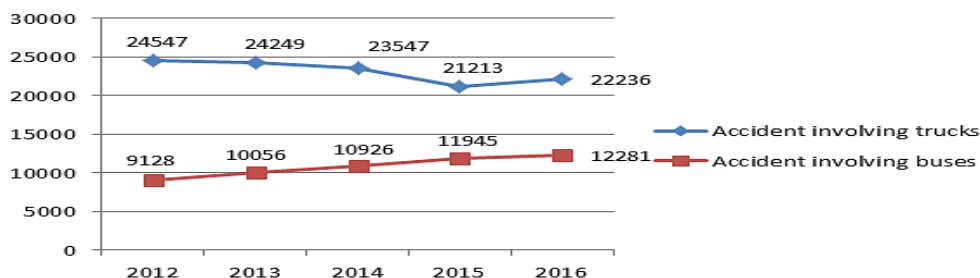
There is a decrease in three main crash rates due to fault of drivers of transport owned by individuals, the share of these accidents has also decreased and has amounted to 87% of all accidents due to drivers' fault. The number of these incidents decreased by 5.5% (131.262), as well as the number of death by 11.3% (15.331), as well as the number of wounded by 4.5% (176.841).

Figure 2. Information about traffic accidents due to fault of drivers of transport belonging to legal entities



The unfavorable situation as a whole develops with the provision of traffic safety in the implementation of transportation activities; there is an increase in all three accident rates, both through the fault of truck drivers and buses (Figure 3).

Figure 3. Information about road accidents involving cargo and passenger transport



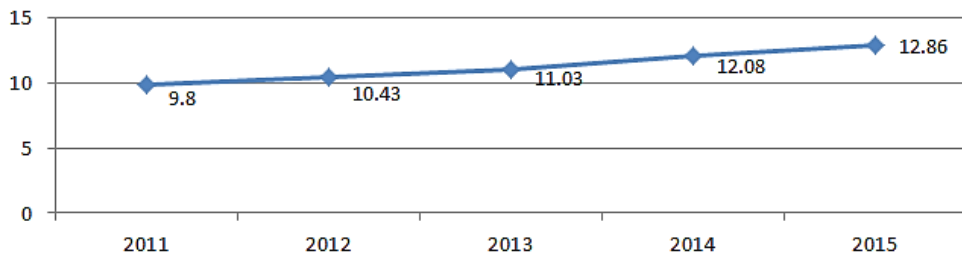
In total, 22,236 (+ 4.8%) traffic accidents have been committed with participation of cargo transport, in which 5,301 (-1.7%) people died and 28,609 (+ 6%) people were wounded. In half of the cases (50%), these incidents are related to violations committed directly by truck drivers, which caused 11,091 road accidents (the level of the previous year), where 1,737 people died (-1.8%) and 14,174 (0.9%) people injured.

Analysis of the causes of this accident indicates the presence in the vast majority of cases of human factor, both on the part of drivers (non-compliance with speed limits, regime of work and leisure, etc.), and on the part of carrier officials (failure to control buses technical condition and pre-trip medical examination). The main conditions conducive to the commission of offenses in these accidents are in the economic sphere of functioning of unified transport system of the Russian Federation, where the goal of economic entities is exclusively to obtain maximum

profit with minimum costs for ensuring the safety of road users. Thus, despite the decrease in absolute accident rates, the state of road safety in the Russian Federation remains a serious social and economic and legal problem. Road accidents, especially those that cause death and injury to people, cause significant social and economic damage.

According to foreign scientists, these losses can be from 2% to 5% of the Gross National Product of the state (World Health Organization, 2015). Unfortunately, the Russian Federation is not an exception. In the period from 2013 to 2015 in Russia, more than 77 thousand people died and more than 740 thousand got injuries of varying severity. Figure 4 shows social and economic damage from the death of an adult in an accident according to the evaluation of the National Research University "Higher School of Economics".

Figure 4. *Social and economic damage from the death of an adult in a road accident, million rubles*



The amount of damage from an accident is divided into direct and indirect losses. Direct (immediate) losses are:

- ✓ losses of owners of rolling stock of motor vehicles involved in road accidents;
- ✓ loss of road maintenance service, including during the elimination of the consequences of an accident;
- ✓ losses of consignors;
- ✓ costs of the State Road Safety Inspectorate and other legal bodies for investigation of road accidents;
- ✓ costs of medical institutions for the treatment of victims;
- ✓ losses of enterprises whose employees became victims of road accidents (payment of temporary disability, issuance of benefits);
- ✓ costs of state social security agencies (pensions);
- ✓ payments of insurance companies.

Indirect losses are:

- ✓ due to temporary or complete retirement of a person as a member of society, from the sphere of material production;

- ✓ due to temporary disruption of production relations at the enterprise (organization);
- ✓ loss of working time for relatives of victims;
- ✓ moral damages of victims;
- ✓ cost of downtime, rerun of vehicles that have not participated in road accidents;
- ✓ losses of public transport passengers who have not participated in road accident.

Elements of direct and indirect losses determine the full assessment of social and economic damage from road accidents. The economic estimation of the damage caused by road accidents, calculated taking into account all components, and makes it possible to objectively determine the amount of necessary financial resources for ensuring security on the country's highways (Lavrikov, 2013).

For the first time the cost of an accident was calculated in the 1950's in Great Britain and the USA. Since then, it is calculated in most countries with a high level of motorization. Until recently, almost all calculations were based on the so-called method of lost production. According to this method, the cost of an accident for the state included the products which were not received in connection with incidents, as well as the costs of treating the injured people and repairing vehicles. Approximately until 1970, the method of under-production was the most common method for calculating the cost of an accident. Since the late 1960's this method became the object of serious criticism from the economists. Two weak points of the method of lost production was shown (Verzilin, 2005).

Firstly, it does not take into account the opinion of road users, i.e., what sum of money traffic participants would like to spend on measures to improve road safety. This means that theoretically this method is not suitable for cost-benefit analysis. In accordance with normative theory, such an analysis should be based on the opinion of road users. Economic expression of this opinion is the willingness to pay for a certain product, for example, for road safety. Secondly, when assessing lost products, the real economic benefit from preventing the accident is greatly underestimated. By making a few plausible assumptions about the utility of using money and the attitude towards risk, it can be shown that a rationally thinking customer is willing to pay for a certain decrease in the risk of death rather than income lost in case of death. In other words, since production in itself is not an end in itself, but only a way of raising the standard of living, preventing an accident that would entail a shortfall in output, it has a higher monetary value than the monetary value of this lost product.

From a theoretical point of view, this criticism of the method of short-received products is convincing. However, in practice, everything is not so obvious. It is very

difficult to get a good assessment of the willingness of a road user to pay for road safety. Several methods are suggested, but all of them have serious drawbacks. A number of studies using various methods have been carried out; however, the results differ greatly. This is due to the lack of willingness to pay for road safety. It depends on a number of factors - such as the level of income, the initial level of risk, the attitude to risk, the nature of the existing risk, etc. In addition, in non-experimental studies in a natural setting, there is almost always an unknown element of self-selection that distorts results. This greatly complicates the interpretation of results in the light of economic theory. In addition to the difficulties of interpretation, all studies have weaknesses in methodology (Verzilin, 2005).

According to the research of the Higher School of Economics, developed countries use a synthesis of approaches to assess the cost of damage from road accidents [8]. Methods of the European Commission for assessing damage from accidents are based on the following components:

- 1) Compensation payments.
- 2) Approach from the point of view of the theory of human capital, calculation of income or GDP (this is a monetary evaluation of the benefits that society will suffer from the preservation of life or human health.)
- 3) The approach in terms of people's willingness to pay for improving quality of life and public safety (based on subjective monetary estimation of damage from a road accident).

The volume of damage from an accident depends on the nature of the used approaches:

- 1) Values of indicators calculated within the framework of "willingness to pay" approach are higher than the total values calculated using other approaches.
- 2) The level of per capita GDP in the country has a significant impact on the final estimate of the cost of damage from road accidents.

Methods for assessing damage from road accidents in the countries of the Organization for Economic Cooperation and Development (OECD):

- 1) Approach from the point of view of the theory of human capital.
- 2) Approach in terms of people's willingness to pay for improving quality of life and public safety.
- 3) Mixed approach.

There is no single approach for all OECD countries. Estimates are based on one of two approaches or on a mixed approach to assessing damage from an accident. With three possible variations, the main element of the assessment is the loss from the death of the deceased or injured in a road accident. The methodology for assessing damage from road accidents in the US includes indicators such as:

- the cost of direct damage (medical costs, administrative costs, market losses, non-

-
- market losses, insurance costs, costs of hiring organization, legal costs);
 - the cost of external damage (the cost of environmental damage, the cost of property damage);
 - the cost of subjectively assessed damage (the cost of reducing the quality of life).

The methodology for assessing damage from road accidents in the UK includes the following components:

- damage to the victim as a result of an accident (direct economic costs, medical expenses, human losses);
- damage associated with road accident (administrative costs, insurance costs, property losses).

The methodology for assessing damage from road accidents in Canada is based on the following components:

- direct economic costs (property damage, administrative costs, medical costs, legal costs, cost of environmental damage, market losses);
- the amount of lost profits (from the loss of human capital of victims as a result of an accident);
- the cost of moral and physical suffering;
- subjective assessment of the cost of human life and willingness of population to pay for minimizing the risks of accidents.

The methodology for assessing damage from road accidents in Australia includes indicators such as:

- loss of productivity (cost of disability);
- non-economic and non-monetary losses (cost of moral damage);
- cost of damage from disability;
- insurance costs;
- medical expenses;
- legal costs;
- assistance to the scene of the accident;
- cost of risks of loss of the workplace;
- the cost of retraining the victim;
- the cost of funeral services;
- cost of police investigation in the event of the death of the victim.

Thus, at present there is no universal general approach to assessing social and economic damage in developed countries, although there is a useful foreign experience. And it should be taken into account when developing the domestic methodology; however simple unadapted transfer of various foreign approaches to the Russian economy is unjustified, since it does not take into account its features.

Domestic methods of recording losses of the national economy from road accidents were based on the principles of planned economy and patterns of growth in national income. The Ministry of Automation Roads of the RSFSR developed an Instruction on the calculation of losses of the national economy from road and transport accidents in the design of highways (BCH 3-81), the period of validity of which was calculated until 2015, but, taking into account political and economic changes in our country, we make a conclusion that regularities and methods of calculation laid down so it requires adjustments corresponding to modern economic relations.

In Russia, since 2000, *"Methodology for the assessment and calculation of standards of social and economic damage from road accidents"* P 3112199-2502-00, which uses the method of general income (economic benefit of preventing the death of a person in an accident), has been applied. The term of this methodology expired in 2005. This methodology took into account losses associated with the death of people who had a family; losses related to the loss of people without a family; losses related to the receipt of disability by the victims, which have completely deprived them of their ability to work; losses related to the receipt of disability by the affected persons, partially depriving them of their ability to work; losses associated with temporary incapacity for work; losses associated with the death of children. Action P 3112199-2502-00 used the method of general income (the economic benefit of preventing the death of a person in an accident); losses due to human death were equated with the state's half-received incomes (per capita GDP).

In this method, attention was focused on the categories of people injured in an accident, which did not allow taking into account all possible outcomes of accidents. Calculations were conducted for Russia as a whole, without regional differentiation. And up to now a comprehensive study devoted to the problem of assessing the social and economic losses of society from road accidents has not been conducted. Currently, due to the lack of a single approved methodology, calculations of social and economic losses from accidents are conducted according to departmental instructions of various ministries, insurance companies and other private organizations that do not take into account all types of losses for various reasons.

1. The methodology for calculating economic losses according to the orders of the Ministry of Economic Development of Russia No. 192, the Ministry of Health and Social Development of Russia No. 323n, the Ministry of Finance of Russia No. 45n, RosStat No. 113 dated 10.04.2012 (ASEDRAR, 2015):

- i) Takes into account only the losses in the production of GDP at the national level.
- ii) Does not take into account regional differences and does not involve assessing losses at the regional and local levels.
- iii) The methodology does not provide scientific and theoretical justification for the chosen approach to estimate economic losses.

iv) The calculation is made only for two groups of the population - children under 15 and for the active population aged 15 to 72 years. Economic losses from mortality, disease and disability for the population over the age of 72 are not taken into account; the size of the life expectancy adjustment factors of up to 72 years for the population under the age of 15 is not given.

v) The calculation formulas themselves do not take into account the amendments to the gender differences of the population, whereas this is important when assessing the life expectancy.

vi) The methodology makes it possible to estimate only the underproduced Gross National Product for the economy of the country as a whole, which does not allow speaking about the lost profits for people expressed in their per capita incomes.

2. The SAR approach presupposes an established amount of compensation payments to the victims as compensation for harm caused to life and health of each victim as a result of an accident.

3. The MES approach to assessing the cost of economic loss takes into account direct and indirect damage, taking discounting into account.

4. Insurance companies offer a wide variety of insurance programs in case of injury and death, although such programs are not available to all insurance companies. A unified approach to assessing the cost of damage from accidents from insurance companies does not exist.

Thus, a unified methodology is not proposed in normative documents and recommendations of public and private organizations on the calculation of the cost of socio-economic damage from an accident. It is necessary to conduct a comprehensive scientific research aimed at creating a new, innovative approach to assessing social and economic damage from road accidents in the Russian Federation, which will allow to reliably determining the volumes of social and economic damage from road accidents and plan actions to reduce it.

4. Conclusions and recommendations

It should be noted that research in the field of social and economic assessment of damage from road accidents in Russia is extremely relevant at the moment, as it raises important issues that need to be resolved in the near future. Without an innovative approach to solving this problem, without developing clear and thorough conceptual provisions of state policy, the situation on the roads can lead to irreversible consequences.

The main sign of an accident from the point of view of a legislator is harm (damage), which can manifest itself in different ways; physical damage (death or injury to a person) and material damage (damage to vehicles, cargo, structures). In practice, however, the range of negative consequences of an accident is not exhausted by the above list. A number of economic losses remain outside the formal definition and, as

a rule, state authorities do not take them into account. These are losses associated with the downtime of transport, training of personnel, loss of working time. The base amount of damage is not determined by the degree of guilt of the infringer, the degree of physical and moral suffering associated with the individual characteristics of the person who suffered harm, the deterioration of the ability of the victim or deprivation of his/her ability to implement them, dismissal from work and other actual circumstances and consequences of an accident (Krivko, 2016). Considering the above, in the Russian Federation, the magnitude of social and economic damage resulting from an accident must include several components:

1. Damage resulting from death and injury of people.

The damage in this case should be calculated taking into account the age and gender structure of dead and wounded people and taking into account direct losses and lost profits in the regional context (ASEDRAR, 2015):

a) In case of fatal outcome:

- direct losses should be calculated as the product of the amount of compensation payments for the loss of bread-winner and the cost of ritual services, on average in the region, for the total number of fatalities as a result of an accident;
- lost profits are defined as the product of the deaths of men / women as a result of road accidents, the number of lost person-years to the average life expectancy of men / women in the region and the average per capita income in the region.

b) In case of disability:

- direct losses are calculated; (total number of people with disabilities as a result of an accident) x (average costs for medical services depending on the disability group + disability benefits x number of person-years for groups of people with disabilities to the average life expectancy of men / women in the region);
- the lost benefits are determined: (number of person-years lost by groups of people with disabilities to the average life expectancy of men / women in the region) x (number of people who received disability) x (disability weight for various groups of disabled people) x (average per capita income in the region).

c) In case of injuries:

- direct losses are calculated; (the total number of injured as a result of an accident) x (the average cost of medical services depending on the category of injuries);
- The lost profits are determined by: (average recovery period for injuries of different severity) x (number of injured people) x (average per capita income in the region).

In the conditions of a market economy, it is impossible to calculate and establish the standard of damage from death or injury of a person in absolute terms, which can be used for a long period. This technique allows you to make an accurate calculation of the valuation of damage for a particular year. This is due to the fact that the assessment depends on the size of the Gross Regional Product (GRP) as the main indicator of the economic potential of a particular region.

In addition, to determine social and economic damage from accidents as a result of death and injury of people, it is necessary to determine the base amount of moral damage and introduce criteria for its specification:

- at a fatal outcome to determine; the degree of guilt of the intruder; the degree of physical and moral suffering associated with the individual characteristics of persons who are members of the deceased's family;
- with disability and traumatism it is necessary to determine; the degree of guilt of the offender, the degree of physical and moral suffering associated with the individual characteristics of the person who suffered harm; deterioration of the ability of the victim or deprivation of his/her ability to implement them; dismissal from work and other actual circumstances and consequences of an accident.

2. Damage resulting from damage to vehicles:

Assessment of damage caused by road accidents due to damage to vehicles takes into account composition of the entities directly affected by damage to motor vehicles in road accidents. The calculation for each entity takes into account the components of the damage, the costs of which they bear:

- The cost of saving a vehicle.
- The cost of evacuation of a vehicle.
- The amount of damage if a vehicle can not be restored.
- The cost of repairing a vehicle.
- The amount of loss of a commodity value of a vehicle as a result of repair work.
- Legal costs.
- The amount of damage due to the time involved in the investigation of an accident and compensation for damages.
- Unclaimed part of insurance compensation for a vehicle.
- Losses associated with transport downtime.
- Losses related to staff training.
- Losses associated with loss of working hours.

In addition, it is necessary to determine; the degree of guilt of the offender, the degree of physical and moral suffering associated with the individual characteristics of the person who suffered harm; dismissal from work and other actual circumstances and consequences of an accident.

3. Damage resulting from damage to cargo:

Assessment of damage caused by an accident due to cargo damage takes into account the composition of the entities directly affected by damage to vehicles in an accident. The calculation for each entity takes into account the components of the damage, the costs of which they bear:

- The amount of damage due to disruption of contractual obligations for the carriage

of goods and passengers.

- The amount of damage due to damage or destruction of cargo.
- Unclaimed part of insurance compensation for cargo.
- Losses associated with transport downtime.
- Losses related to staff training.
- Losses associated with loss of working hours.

It is also necessary to determine; the degree of guilt of the offender, the degree of physical and moral suffering associated with the individual characteristics of the person who suffered harm; dismissal from work and other actual circumstances and consequences of an accident.

4. Damage resulting from damage to roads and road structures:

Damage from damage to road structures as a result of an accident is determined by the amount of costs for the subsequent rehabilitation of roads, road and roadside structures. All the indicators need to be translated into monetary terms when carrying out the cost analysis in the context of the components of social and economic damage as a result of an accident to recover moral damage.

Inclusion in the assessment of social and economic damage from road accidents of moral damage from road accidents will allow us to expand the practical basis for its compensation, to determine the amount of damage more accurately and plan measures to reduce it, prevent damage and protect the rights of citizens, society and the state in this area, which will undoubtedly contribute to development of the state.

Social and economic assessment of damage from road accidents is necessary for making managerial decisions in the field of road safety. Knowing the size of damage makes it possible to assess the magnitude and significance of the road accident crash problem objectively, determine the amount of financial and material resources that should be sent to solve it, assess the effectiveness of various activities and targeted programs that contribute to reducing accidents and ensuring road safety. Estimating the cost of losses from road accidents and bringing this information to the public warn people about the threat to their lives and health, contribute to their awareness of the importance of road safety activities and formation of public support for their implementation. The proposed approach to improving the methodology for assessing the magnitude of social and economic damage from road accidents corresponds to world practice, as well as social and economic situation in Russia.

References:

- ASEDRAR. 2015. Assessment of social and economic damage from road accidents in Russia. Methodological issues in the context of foreign research. Higher School of Economics - Moscow.

- Kaziakhmedov, G.M. 2015. Methodical aspects of assessing economic losses from road accidents. Bulletin of the Academy of Economic Security of the Ministry of Internal Affairs of Russia, 7, 87-91.
- Krivko, E.V. 2016. On the methodological approach to the assessment of social and economic damage from road accidents. International collection of scientific papers Far East. Roads and traffic safety. Publisher, Pacific State University (Khabarovsk), 174-179.
- Lavrikov, I.N. 2013. Definition of economic losses from road and transport incidents. Issues of modern science and practice. V.I. Vernadsky University, 2(46), 27-31.
- Potseluev, P.A. 2012. Methodological principles of social and economic assessment of road accidents as a tool for ensuring economic security. Bulletin of Moscow University of the Ministry of Internal Affairs of Russia, 2, 125-131.
- Verzilin, V.A. 2005. Road safety: organization, efficiency, development prospects. Voronezh, Scientific Book publ., 328.
- Verzilin, V.A. 2009. Social and economic losses from road accidents (on the example of the Voronezh region). Bulletin of Tambov University. Series, Humanities, 12(80), 154-161.
- World Health Organization report. 2015. On the state of road safety in the world 2015, http://www.who.int/violence_injury_prevention/road_safety_status/2015/GSRRS2015_Summary_RU.pdf.