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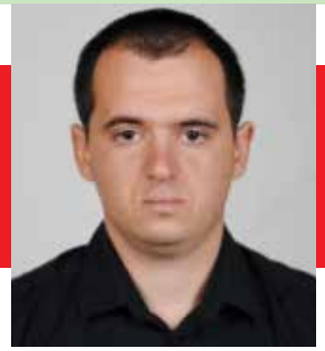


EXTERNAL COSTS OF ROAD ACCIDENTS IN THE REPUBLIC OF BULGARIA

INTRODUCTION

The external costs of transport are an actual topic on a world level. At European level, the European Union, in the face of the European Commission, has the ambitious goal of reaching a maximum accurate algorithm for identifying and internalizing external costs, with a number of studies being financed and even legislative changes initiated. Conclusions that have been made at the moment are united by the fact that transport together with its uncontested benefits also brings many damages, which are undervalued and unconscious by the users. It is for this reason that the European Union's clear decision is to define external costs and find a mechanism for transmitting information to consumers. In Bulgaria this theme is new and there is no common concept and understanding of the external costs of transport.

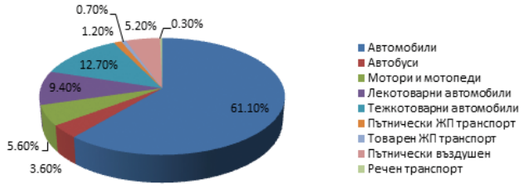


Figure 1 – external costs of transport (by transport mode), EU 2008

In order to clarify the situation, as in every aspect of our life, differences between the individual benefits (those of the individual user of transport) and those of society (which are formed by all other people, future generations and the state) must be made.

Looking at the perspective of the individual user, transport (which includes all vehicles, infrastructure, rules, etc.) is an essential part of our daily life and the benefits of transport are enormous for every trip - the benefits are more than the cost, otherwise the trip will not has taken place. This is fundamental. Looking at the situation from the perspective of society, a completely different picture appears. The fact that the trip has more benefits than costs for the individual user does not mean that the benefits to society will be more than the cost. Following this, from a society point of view, a much more detailed analysis of general public costs and general public benefits is needed.

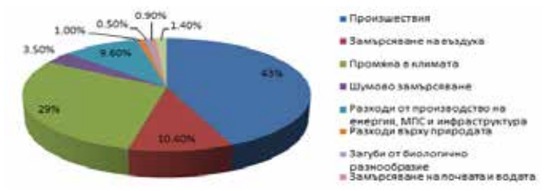
Such a societal analysis is much more complex, and it needs to include all external benefits and costs. The European Union, in the face of the European Commission, as well as many other countries and organizations, have been discussing for a long time the side effects of transport.

This task seems and it is impossible to solve by a purely scientific method. It is impossible to calculate real benefits for future generations of embarked journeys today, it is equally impossible to calculate the damage that this trip will bring to future generations. In this sense, it is sufficient to create a continuous process of monitoring and updating the costs and benefits suffered by the public and that it is clear to every user when making a decision to take a trip. Due to the origin of the problem, we will never get to the exact price and its accurate internalization, but it is absolutely essential to stick to it, update it regularly, and internalize properly. **In conclusion, it is sufficient to create a permanent monitoring process for controlling and identifying external effects, to define them with maximum accuracy and information to be passed on to users accurately and clearly.**

For the common good, it is necessary to internalize all current external costs because the user can act effectively only when the cost of the trip includes all the costs. In order to develop this topic, we need to balance the benefits and costs of society.

Total external transport costs in the EU, together with Norway and Switzerland in 2008, cost more than 500 billion euros or 4% of the total gross product of the community. About 77% of the costs are caused by passenger transport and about 23% of freight. In addition, the cost of congestion in Europe is estimated at between 146 and 243 billion euros (between 1 and 2% of GDP)

Road transport has the largest share of these costs - about 93%. This can be explained by the large share of road transport in the total volume of transport and their higher share in the average external cost per passenger kilometer or tonne - kilometer. Cars have a share of about 61%, heavy trucks are 13%, lightweight 9%, bikes and mopeds 6%, and buses 4%. Of the other modes of transport, air transport has the largest share in external costs - around 5%. Rail transport is responsible for less than 2% and the river for only 0.3%. Maritime transport is not considered within the EU.



EXTERNAL COSTS OF ROAD ACCIDENTS

Road accidents happen for a part of a second, but their consequences can last for months, years or even the rest of their lives. Most of the victims of road accidents recover fully, but others never recover and suffer from various types of disability for life. In Spain, for example, according to current research, 15% of survivors of road accidents should be treated in hospital for at least one day, 32% should go to hospital for up to three months and 29% should be out of work for a longer period.

Road accidents affect not only the global economy but also households. Victims of road traffic accidents are mainly young people, three out of four victims are men, most of the victims are people who carry the main income in the family.

The severity of road accidents does not only affect those who are directly involved, but also their families and relatives. A survey carried out by the European Federation of Road Traffic Victims found that 90% of the families of the death people following road accidents and 85% of the families of disabled victims said significant, and in half the cases even a dramatic and steady decline in their own quality of life and / or their standard of living (compared to the time before the crash).

This study was later followed by a questionnaire of 1 364 relatives of death or injured users. It shows that a very large proportion of the relatives of those who died and those who were seriously injured, as well as the victims themselves, suffer from psychological problems, including the desire for suicide (37%). In most cases, these symptoms persist even three years after the event, indicating that these types of injuries are extremely long-lasting and even permanent. With the exception of "the desire for suicide", relatives of the victims show similar symptoms with the relatives of the dead.

In 2004 a study was carried out on consequences for parents whose children were involved in crashes. 84% of mothers experience the accident again and again, 81% suffer from sleeping problems and 16% have all the symptoms of acute mental disorders. Mothers who were direct witnesses have even higher scores.

With regard to the impact on productivity, 60% of the relatives of the death, 80% of the disabled and 70% of the disabled themselves change their place of residence due to the circumstances and consequences of the road accident. Between 33% and 65% lose their jobs due to physical or psychological consequences.

In addition, to the loss of life or reduced quality of life, road accidents have many other consequences for survivors, such as legal, financial and psychological consequences.

The road safety role of the road is key to the safety. Therefore, by improving the road and its elements, as well as improving its maintenance and management, the safety will be reduced. The construction and maintenance of road infrastructure follows market principles - priority is being given to projects that are economically more

advantageous. It is, however, necessary to supplement the information on the basis of which decisions on economic efficiency are added, adding the external costs generated by transport and, in this case, the road, thus making more informed and motivated decisions.

In this sense, by exploring road safety, respectively the role of the road to the safety, additional knowledge and tools will be acquired to be used to improve traffic safety. The external costs resulting from crashes should be internalized and funds used to improve the road to reduce crashes. This can happen, both globally in defining national policies and transport strategies, and locally in defining the design elements of the roads. In practice, this means that by adding the external costs of road accidents to analyzing the efficiency of investments in road infrastructure, it may be that a project that is inefficient is becoming economically viable or re-arranging the priorities for construction and maintaining the road network. The same is true for design elements on the roads, once again taking into account the economic impact of external costs as a result of crashes, it may be that a certain element is more profitable than another.

ANALYSING THE METHODS AND THE METODOLOGIES

In the specific research, 6 methods have been identified, after a detailed analysis of all, it has been decided to use a combination of two - the gross output approach and the risk-based approach, which is also the world practice.

The gross output approach includes the direct damage suffered by the state or the society, the costs of medical care and treatment, the administrative costs incurred by the police and the court for investigation and termination of the road accident, the material damage suffered by the users and the state and municipal administration for damaged property, as well as the indirect costs associated with the loss of contribution to the gross product (GDP) of the state. In this connection, correspondence was held with the bodies responsible for healthcare, police, judicial system, insurance companies, the road administration and municipalities for material damage to public property.

The net output approach is analogous to the gross output approach, taking into account that a person will consume much of what he produces. In practice, the value is obtained by consuming the gross output. This method is very rarely used because there are several significant disadvantages. First of all, when a person retires, therefore, stops producing, and only consumes, his value will become negative. In addition, a person consuming goods generates a product for other people and therefore should not be consuming the entire value of consumption. However, this is in practice impossible to determine with sufficient precision.

The life-insurance approach determines the value of human life based on the sum insured that people choose for Life insurance. This method focuses exclusively on the subjective judgment of each person, giving value only to intangible costs. Considering that Life Insurance, according to data of the Financial Supervision Commission, was concluded by only 1 156 627 people, ie. about 15% of the population of the Republic of Bulgaria, and the fact that a large part of these insurances for compulsory mortgage loans are distorting the results for several reasons - first the sample is too small and there are no statistics available to people who have entered into this insurance, and there are also accurate statistics on the number of insurances and premium income but there are no statistics on individual indemnities paid or statistics on insurance coverage. Secondly, as insurance is required by a large number of banking institutions, it can be assumed that the majority of mortgage lenders have concluded similar only because of the mandatory requirement of banks. Therefore, they have chosen the insurance mainly according to the premium, rather than the coverage of the insurance itself, and therefore the insurance value in the policies can not be considered as real. Last but not least, mortgage loans are used by people of a certain standard who do not correspond to the average citizen and therefore do not represent a representative sample. In this regard, the state of life in Bulgaria does not allow us to obtain the necessary information on this method.

The court award approach determines indirect individual damages, based on the amounts determined by the court in case of death. Taking into account that the insurance system pays damages for death in crashes, these values depend exclusively on what insurers are willing to pay to the relatives of the death. Due to the lack of precise methodology for calculating damages, these costs are subjective and, in each case, considered individually. At the request of the Financial Supervision Commission, insurers develop methodologies to determine benefits. However, these methodologies are too subjective, there is nothing specific about them and

the assessment is extremely subjective. Subsequently, the same was confirmed by "Groupama Life Insurance" EAD, upon request. It should be borne in mind that the lack of such a common-law methodology allows insurers to charge very low premiums for compulsory Third Party Liability insurance and therefore to pay very low insurance benefits. In view of the above, the court indemnity is in fact equal to what insurers pay (this statement is also confirmed by "Groupma Life Insurance") and this amount depends exclusively on the collected premiums. The circle of the victims of death is governed by Decree No. 4 / 25.05.1961; №5 / 24.11.1969 and №2 / 30.11.1984 of the Plenum of the Council of the People's Republic of Bulgaria, which stipulates that compensation is due only to parents, children, spouse. This makes the reimbursed circle very small, which is inconsistent with the concept of external costs of road accidents. Therefore, the values obtained by this method will be unrealistic and extremely tied to the insurance system.

This method will not provide real data, but given the specificity of the problem, the values paid by insurance companies are internal and should be deducted from the total. Therefore, an analysis of the benefits paid by insurance companies has been made and thus the internal part of the Indirect Damage component is determined.

The implicit public sector valuation approach gives value based on the costs incurred for the prevention of crashes. The values obtained through it would also be unrealistic due to the subjective factors associated with prevention policies. In practice, the figures are based on the costs the state is doing to prevent road accidents. This method is not applicable.

The risk - based method **(The value of risk change or willingness to pay approach)** is the most preferred method of assessing human life on a European and global scale. It is based on the willingness to pay (WTP) probability approach, which is based on the willingness to pay a person, a group of people, the public, and the government to reduce the risk of crash. In practice, results are obtained through stakeholder questionnaires. Naturally, there are shortcomings in this method, which are mainly related to the preparation of the survey and the representative sample. Since the problem is specific in the specific case and the population does not have enough information, the questions need to be chosen very carefully so as to ensure that the answers that are received will provide the necessary information.

Figure 3 – Approachs (methods) / components

All the components have been identified and a detailed analysis of each of them has been made, whether they are external or internal. Accordingly, in the course of their work, they were calculated wherever possible. The problem in Bulgaria is the lack of statistics and information on the costs of hospitals, prosecution and police (direct costs) for costs incurred as a result of crashes. GDP data is available and updated on a regular basis, indirect costs are calculated in the specific research. The direct cost problem is solved by using translational ratios to match them to the indirect ones. Components in Bulgaria follow the logic of other countries with similar systems, with the exception of the cost of damage to public property. Analysis has shown that this component has an external part that is significant and it is necessary to complete a study to identify the specific problem and to seek a solution.

All global methodologies have been analyzed and a model for calculating external costs as a result of crashes has been established.

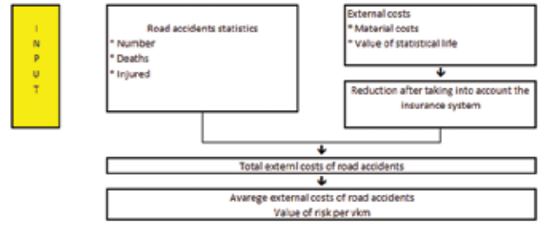


Figure 4 – Block scheme for calculating of external costs of road accidents

The main element of the model is the road accidents statistics, including data on the number of crashes, deaths and injuries. Damages are divided into material and non - material (direct and indirect), and intangible include the economic value of the pain, suffering and grief of people involved in crashes and their relatives - most commonly expressed as "Value of Statistical Life". After the determination of the value of the statistical life, a reduction was made taking into account the effect of the insurance system. As explained above, what has been done

for direct costs (by gross output approach) and what are the problems with them. Losses from contribution to GDP are calculated and values will be shown at the end of the article. I will deal in detail with the risk-based method and the determination of the cost of the statistical life, with the figures including the reduction from the insurance system being shown at the end of the final algorithm.

RISK BASED SOCIOLOGICAL STUDY

Risk-based methods are widespread. They are based on the "Willingness to pay" approach.

The probabilistic approach of "willingness to pay", in this case to reduce the risk of fatal accidents, has become a standard method of assessing human life in economic theory. This approach begins with the following main question: Suppose that the user has the opportunity to buy an E reduction in his probability of dying. What is the maximum amount he will pay for the probability of increasing his life? If he / she will pay the most C for E, then we say that he / she assesses his / her life in C / E. Usually this is for very low values for E, in this case we put the respondents in a real environment with real data – 100 deaths per 1 000 000 inhabitants. We asked them to rate different reductions - 20%; 30% and 50%, which in practice means 20 / million; 30 / million and 50 / million. This gives the coefficient E = 0.00002. The model is simple enough, so much so that the "value of statistical life" will be decided as a simple function of the relative risk assessment.

The survey was conducted in December 2017, covering about 1,400 respondents, expecting about 800 real responses representing a representative sample of society.

The questionnaire contains four categories of questions:

• Personal experience with traffic accidents - Respondents are asked to respond to whether they personally and / or their relatives and friends have been in an accident involving victims or severely injured

• Used means of transport - this category allows to describe the most commonly used modes of transport by individuals, as well as the use cycles

• General socio-economic characteristics - this category collects information about gender, age, residence, family status and professional status and thus determines the social status of the respondent

• Payment Acceptance for Risk Reduction - This part is the essence of the contingency assessment. This requires the creation of a fictional scenario, albeit realistic and comprehensible, on which respondents will be called upon to think. They will then have to express how much they would like to pay to reduce the risk of death from a traffic accident. The level of risk reduction depends on a set of different questions and answers.

Respondents have the opportunity to contribute financially to the implementation of a regional and national projects aimed at enhancing the safety of road users. Since the participants themselves are residents of the respective region (in this case municipality) and of the country, they will feel directly concerned about the project. Participants are asked to determine how many BGN they are willing to pay monthly to the municipality or the government to implement the project. In addition, regardless of municipal or national policy, a control question was asked about individual risk-sharing costs, and it was also referred to relatives and friends.

Question №	Reduction	
R5_1	20%	Imagine having the opportunity to travel from home to your workplace on two routes identical to travel duration, comfort and speed. On the first route, the chance to die in crash is 100 / 1,000,000 (one hundred to one million). On the second route, the municipality has provided a more serious police presence and other measures that reduce the risk of dying following road accident. How many BGN would you pay monthly to travel on the second, less risky route?
R5_2	30%	The same question, but different percent reduction
R7_1	30%	Imagine that the government has a program that ensures that it will reduce road deaths by 30%. In order to finance this program, funds will be collected monthly from citizens. How many BGN would you spend a month from your own income to help this government program?
R7_2	30%	The same question, but the payment is for the whole family.
R9	50%	Imagine that you can add extra to your car that reduces the risk of dying following road accident by 50%. You must pay a monthly fee for this extra. How many BGN a month are you willing to pay?
R10	50%	Imagine that a close friend or a relative asks you to buy the same extra. How many BGN a month are you willing to pay?

Figure 5 - Questionnaire

In conclusion, the questions are selected so that they put the respondents in a real situation and to be easily assimilated by them. The main purpose of determining the individual risk assessment is achieved by asking questions in different hypothetical situations where respondents are asked to answer in exact amounts (in an open response without a frame (as choose between answer a,b,c,d)), who are willing to pay monthly against a fixed percentage of risk reduction (which is considered to be guaranteed). This is used on the one hand to determine the value of the "cost of life" of each individual and hence the "value of statistical life" for the sample and secondly to eliminate the false answers. Example: If the same respondent evaluates a 20% risk reduction with a higher risk reduction of 50% then it is obvious that his/her judgment is not realistic and should be eliminated from the sample.

The questionnaire was assigned to 1406 people, with real answers being received by 755. This is in line with the goal of getting around 800 respondents. By comparison, such studies in other countries are considered valid. In France, this was done by 600, in Egypt by 400, by 210 in Sydney, Australia, by 342 in Chile, by 500 in Saudi Arabia and by 1,000 in Sweden.

To get real value, invalid results need to be removed. The methodology requires zero values to be removed as a first step. After they were removed, the data of 525 respondents remained. It is then necessary to examine and analyze the results of each respondent individually, the purpose here being to eliminate the invalid ones. Invalids are determined on the basis of the following principles: We assume that each person values their lives more than any other, so respondents who have given a higher risk to friends at their own risk are excluded from the survey - it is assumed that they are not correctly adopted the questions, therefore their results are invalid. On the same principle, the results of the questionnaire R7, which assess the risk in the same situation for the person as well as for the whole household (including him / herself) - if the respondent gave lower value to the whole household of your personal, then it is eliminated because the value of the remaining members of the household will be negative. The third check is based on the individual risk assessment. It has become clear that the questions are structured so that their correctness can be assessed after an appropriate analysis. A 20%, 30% and 50% reduction of individual risk is set if one of the respondents gives illogical answers - for example, a 20% reduction gives a higher value of 30% or 50% or a 30% reduction gives - a high 50% reduction, it is eliminated from the sample because it is assumed that he/she did not correctly take the matter and its answers are invalid.

After eliminating these respondents, the sample remained with 387 actual responses from which real information could be extracted. The value of statistical life at a 50% reduction (E = 0.00005) obtained by two distinct questions - R5_2 and R9. Values vary by less than 4%, which is within the range of the statistical error. This means that the respondents reasonably assessed the small changes at their own risk and gave an additional positive assessment of the questionnaire and the results obtained.

Expectedly, the values obtained at 20% reduction are higher than those at a 30% reduction, respectively those obtained at a 30% reduction are higher than those obtained at a reduction of 50%. The difference between the highest and the lowest is 27.9% of the highest. However, the values are within reasonable limits, they are not extreme, and they are mostly in the order set in other countries. For determining the final value of the statistical life, we will calculate the weighted average of all, which is BGN 320,028.

The cost of damage to relatives and friends is received by two questions R7_2 and R10. Between BGN 267 093.48 and BGN 223 392.81 were received. Here again the values are in order and overlap with those in other countries. Again, the value for relatives and friends will be calculated as a weighted average of the two - 246 737.79 BGN

The final algorithm is the following

$TC = A (VSL + C_5) + dc = A (1.1VSL + C_5)$

$A = 682 * 1 * 1.02 + 1943 * 0.13 * 1.50 + 6737 * 0.01 * 3.00 = 1\,276.63$

$VSL = a + b - ins = 320\,028.00 + 246\,737.79 - 112\,982.46 = 453\,783.33$ BGN

$C_5 = GDP * (ww \times dw + wm \times dm) / (dw + dm)$

$C_5 = 27,977.70 * (8 * 186 + 19 * 496) / (186 + 496) = 447,643.20$ BGN

$TC = 1\,276.63 * (1.1 * 453\,783.33 + 447\,643.20) = 1\,208\,719\,492.25$ BGN

Where,

TC - Total cost

A - the number of deaths following road accidents. Data for 2017 was used. 682 deaths, 1943 seriously injured, and 6737 slightly injured, corrected with correction factors for statistics deficiencies and unreported accidents, correction factors of 1.02; 1.50 and 3.00. Coefficients have been used for equating the victims to the dead.

VSL - Value of statistical life. Where "a" and "b" are the respective values for the value of the own risk and the value of the risk for relatives and friends, ins is the reduction from the insurance system.

dc - direct costs, including the components (c_1, c_2, c_3, c_4) for health, police, judiciary and public property damage

C_5 - losses on contribution to GDP. When calculating C_5 it was diversified on a male and female basis, given the different retirement ages and the different average age at which men and women die (following used data from 2017).

ww - working years women - remaining years to a retirement for women in case they did not die in crashes

wm - working years men - remaining years until a retirement for men in case they did not die in crashes

dw - death women - women killed in crashes

dm - death men - men killed in crashes

Final values

• Serious crash – BGN 175 481.92

• Death – BGN 946 804.86

• Seriously injured – BGN 123,084.63

• Slightly injured - BGN 9 468.05

• External costs of road accidents in Bulgaria for 2017 - BGN 1,208,724,222.45

In conclusion, the value of one death person is compared to those obtained in other countries. A euro equivalent is approximately € 484,000.00. This value is comparable to those obtained in other European countries where a value of between EUR 275 000, Lithuania and Latvia and EUR 2 893 000 in Norway is obtained. The value obtained for the Republic of Bulgaria is close to the values obtained in the Czech Republic (EUR 495 000); Hungary (EUR 440 000); Estonia (EUR 352 000); Poland (EUR 341 000).