

# ANALYSIS OF COST CALCULATION MODELS OCCURRING IN TRAFFIC ACCIDENTS AS WELL AS SUGGESTING A NEW MODERN AND MORE EFFICIENT MODEL FOR CALCULATING THE SAME

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## Abstract

With the rapid development of the production of motor vehicles and their utilization and their participation in the traffic, and with the occurrence of traffic accidents as well as the consequences that occur due to that. A real calculation of the costs that occur as a result of traffic accidents also appears as a problem. Therefore, a model is required for real calculation of the same, and the European model as well as the existing model in the Republic of North Macedonia is not sufficiently processed.

During the preparation of this paper is given an overview of the procedures and methods of processing and calculation of the actual damages caused by traffic accidents, as well as the insurance system for the occurrence of traffic risks that is applied in insurance companies in the Republic of North Macedonia. The European model that is currently in use, the existing model in the Republic of North Macedonia, will be analyzed, and a new model for calculating the damages from traffic accidents, and the scope of their coverage and definition, as well as the costs of traffic accidents and the tangible and intangible costs. The purpose of this paper is to address the special emphasis and is given in defining and calculating intangible costs, in analyzing them.

**Keywords:** accidents, costs, calculation, real, insurance model

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## 1 Analysis of the European model for calculation of accident costs

This model for calculating the costs arising from the occurrence of traffic accidents has been developed by European experts under the title "Final report of the expert advisors of the high level of the cost system" from the so-called "Working Group 3". The group was led by Swedish Expert Dr. Gummar Linderber. In the report, the working group points out the complexity of the issue and that the duties are not realistic until they reflect all the duties, including the external costs of traffic.

The group further points out that the cost of traffic accidents is one of the highest in traffic. The group also suggests that different elements of possible or marginal costs need to be taken into account in the calculations. Finally, the working group proposes that it is necessary to take into account the risk of an accident, the average costs, as well as the difference that may occur with the application of different models. All research, the working group mainly focuses on the cost of rail and road accidents. Final external costs of traffic accidents are mainly estimated by the increase of accidents in society, including victims, damages to families or close relatives, including those who caused the accidents.

Important factors, based on which the cost of traffic accidents is estimated, are, above all, the links between the risk of accidents and the density of traffic. Traffic accidents primarily depend on the density of traffic,

the type of vehicle, the road, the driver of the motor vehicle (psycho-physical health, age, training and behavior), etc. The external costs of traffic accidents are higher when trucks and buses are involved, compared to passenger cars. These different categories should be used when considering the different approaches to determining and predicting the costs of traffic accidents. Having in mind the identified risks for the occurrence of traffic accidents, the costs can be divided into two basic categories: Material costs that include damage to property (vehicles, goods, infrastructure, etc.), administrative costs, medical costs, etc intangible costs are dominated by external costs that is emotional (suffered fear, pain, reduced life activity, resentment, etc.) and social costs from accidents.

The use of premiums by insurance companies is also taken into account. In the insurance industry, the premiums vary according to the reflection of well-defined levels of risk of traffic accidents and their costs. The working group is convinced that the sophisticated insurance structure based on detailed risk, information and reflection of the various variable components of the costs of traffic accidents, is the most satisfactory delivery tool for determining the external costs of traffic accidents. The development of all these cost assumptions requires more detailed study of the data in both reports and publications. In particular, it is necessary to study the socio-economic costs of traffic accidents.

### 1.1 *Defining the final external costs*

The cost has long been calculated as a simple average cost, with more or less qualified appropriation of accident cost allocation between internal and external components. However, the working group believes that there is enough information available so that traffic insurance can go a few steps further.

Basic principles, the ultimate external costs of traffic costs are in fact the increased costs of accidents supported by society as a whole, including family or relatives, and may include costs incurred by victims of traffic accidents. The aspiration for external collection of accidents aims to increase the operation of the traffic system, with the basic conclusion from the general economic theory which states: "*collection should internalize the external border costs*". Internalization based on the *polluter pay* (PPP) principle is generally accepted as a "fair" principle. In the context of a traffic accident, the polluter pays principle can be expressed as: The person who poses a risk to others, that has caused the accident, should be responsible for the excess cost. The cost of a traffic accident, ex ante (with priority) can be expressed in three components:

1. the cost of security for some of those traveling in a particular model at risk,
2. expense, which is also intended for part of the parents / children or relatives of that person,
3. cost to the rest of society.

The user accepts the risk to which he exposes himself is assessed as his consent to payment. The remaining costs, the final external cost consists of three components:

- a) System exterior - expected cost of accidents in society, when the user puts himself at risk, when he gets involved in traffic, most often medical and hospital costs.
- b) External traffic density - household cost (consent to payment), close persons.
- c) c) Exterior of the traffic category - household expenses, relatives or close persons and the rest of the society.

In urban areas we can find two different types of interactions between accidents and traffic density. Accidents involving only motor vehicles seem to increase progressively with the density of traffic, while accidents involving motor vehicles on unsecured (unprotected) roads increase depressively. Finally, it can be concluded that all three types of exterior are presented in an urban environment:

1. Elasticity of accidents, vehicle-vehicle is positive and generates external traffic density;

2. The number of accidents with protected users on the road is important and it regulates in a suitable external traffic category;
3. When equalizing, the included external cost is most likely with reduced costs in low Trafficdensity and traffic density costs increase slowly.

### 1.2 *Insurance systems applied in European countries*

In all EU countries, there is a legal obligation that obliges motor vehicle owners to be insured with respect for liability for personal injury and damage to a third person. The motor insurance industry was deregulated in the EU. However, the process of adaptation to deregulation has not yet stabilized. The different Member States have progressed to varying degrees, with the United Kingdom making the fastest progress in this direction. Although the internalization through insurance systems is in the interest of all traffic models, here it will be processed, primarily road traffic. In the EU, in most countries, the responsibility is based on the fault / error system. If this cannot be proven, then the compensation cannot be paid. However, in some European countries, the principle of liability based on fault / error is imposed unconditionally on road traffic accidents. This is the case in Belgium, the Netherlands, Luxembourg, Italy, the United Kingdom and Ireland. In countries such as the United Kingdom, Ireland and Belgium, the injured party is required to provide valid evidence of fault / error. However, in Italy, the Netherlands and Luxembourg the blame for the damage has been partially lifted until the culprit has provided evidence to the contrary. In the Netherlands the presumption of guilt is implemented in a period (benefit) of a non-motorized victim. Other European countries have a system of strict responsibility, such as: Denmark, Spain. Germany and France, regardless of fault, the driver and the owner are liable for bodily injury or death of non-motorized victims, if the victim is injured or killed, is under 16 years of age or older than 70 years or has at least 80% disability. In this case, neither the existence of an inevitable event nor the negligence of the injured party can lead to liability. Spain and also Denmark have principles of material damage liability, but strict liability in case of bodily injury. In this way, three different. Finally, we can note that all of these procedures look like a mix of systems, which may be correct for internalizing the costs of accidents approaches are represented in the liability insurance of the participants in a motor vehicle accident. Strict responsibility, in relation to relatively vulnerable categories of road users (vehicles in urban road system), such as: car accidents, pedestrians with motor vehicles, railway vehicles (at crossings), it is necessary to internalize the exterior of the traffic category. In many EU member states, the state insurance or social security authorities are entitled to full compensation, that they cover the costs caused by the victims of traffic accidents.

### 1.3 *Turning to a special analysis of the model applied in European countries (European system)*

The liability insurance system is not aimed at preventing traffic accidents or internalizing external costs. However, the system has a security effect, which should be taken into account. In the model of the European Union, three different approaches are taken to the liability for motor insurance:

1. If traffic accidents are observed as profitable events, with equal cost burden, regardless of the behavior, then the system error is taken as appropriate.
2. If the behavior of the vehicle is observed as an important priority part, then the fault system can be favored or the faultless system with bonus / mollusk. If the cost burden always falls on the other side (for example protected road users), then a strict liability system could be favored.
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From the above, it seems that the mix of systems may be adequate to internalize the cost of traffic accidents. Strict liability in relation to relatively unprotected road users (passengers, pedestrians, cars and railroad crossings) can certainly be the basis for internalization. Based on the current practice in the EU member states, it can be concluded that in case of a traffic accident with fatal consequences (fatal outcome) the difference between the sacrifice and the possible reward is alarmingly large. In that case, the insurance system will be far below the internalization of the costs of accidents with a fatal outcome. It is obvious that

the insurance system in the member states can cover the costs of accidents with injured people surprisingly well.

Therefore, it can be concluded that the coverage of costs in traffic accidents with fatal consequences can be increased by introducing appropriate fees (charges). The new laws in the road traffic of the European Union transfer the responsibility for insurance in case of a traffic accident to the insurance companies and create an administration that will have only a control function. All comparisons, reflections and analyzes of the models applied in some EU member states lead to a single conclusion, which is that the European Union does not have a single model for clearly differentiating and defining the costs (especially intangibles) that occur in traffic accidents, and which should be financially supported by the insurance industry. It is more than obvious that the European Commission is putting pressure on EU member states in terms of creating a single model by clearly defining those costs and their financial coverage. In some countries (Sweden, Great Britain and other countries), there is a breakthrough in the design of the model. Still, many countries have retained the model with annual fees covering hospital, some other medical expenses, court costs, etc. The method of internalization should encourage the user's behavior in a positive sense (behavior that leads to the reduction of accidents). This method is important because every charge or premium is related to an activity / decision that generate a traffic accident such as:

1. Distance (or for example, non-stop driving for hours)
2. Behavior and skills of the driver;
3. Selection of vehicle and safety equipment.

The prevailing opinion among experts in this field is that "mileage charge" as well as "fuel price" have an impact on vehicle technology and driving distances.

In the end, it will be concluded that what the experts from the EU member states recommend is very important, and for us it is deregulation in the insurance system and covering the costs of traffic accidents, and only to avoid the monopoly position of some insurance company. This means the introduction of a market economy in this area as well.

Opportunities for introduction of this concept in our country, in today's conditions the system is difficult to apply, due to low standard of citizens, and high unemployment. However, this does not mean that at this stage of development of our society, we should not continue to study, that research the optimal model to cover the costs arising from traffic accidents.

## **2 Analysis of the model for calculating the costs of traffic accidents that is applied in the Republic of North Macedonia**

### *2.1 Experiences for calculation of costs from traffic accidents in Republic of North Macedonia*

The model for applying a claim management over its lifetime may be different, depending on the processing and resolution procedures in insurance companies.

Usually the process of processing and resolving the damages takes place in several stages.

The composition of the team from the insurance company, in terms of damages, should be based on extensive experience combined with knowledge and skills in several areas, such as: experts in the field of vehicles, experts in the field of industry, construction, services, information technology, experts in agriculture, forestry, water management, environmental protection, banking, cash, lending, medical, and medical services, insurance, legal, financial works and other areas related to this issue depending on the portfolio of each company individually.

This should be a prerequisite for providing good customer service, combined with highly sophisticated information technology, without which progress in the insurance industry is unthinkable. Above all, insurers have insured clients, with highly sophisticated knowledge, and their potential requirements for a fast, simple and acceptable way of compensation, or payment of damages in the shortest possible time should be understood.

## 2.2. The period of the procedure for conducting inspection and examination of insured persons

This type of insurance assessment is evident in the need to use external medical experts and specialists. The forms of contracts and related services are defined by the insurer depending on its needs.

Persons in charge of conducting the procedures, appoint an assessor - doctor-censor, to inspect the submitted medical and other documentation, and depending on the injury and insurance as needed and examination of the person after a certain period of the harmful event, the completion of treatment, such as: accident with death from illness, accident, injury, managerial insurance, additional accident insurance after A / O, hull, life, etc., travel insurance, life, death of the insured, death from accident, expiration of policy, advance by policy, redemption by policy.

The insured that is injured due to an accident is obliged to call a doctor immediately to provide the necessary medical first aid and other needs for repairing the injuries from the accident. To inform the insurer in writing about the accident, to report the damage and submit the necessary data, as follows: place and time of the accident, full description of the event, name of the doctor who performed the treatment, doctor's finding, data on the consequences and bodily injuries, etc.

When organizing an examination by the censor doctor, preparation is made for a detailed study of the accident report, the attached documents and the insurance coverage.

### 2.2 *Procedure applied for performing examination of insured persons.*

If the insured is injured by an accident, the insurance beneficiary, the insured is obliged to notify the insurer in writing and to obtain the necessary documents.

Examination of the insured is performed by a doctor censor. From the documentation the doctor gives an opinion and determines the disability of the person.

The entire documentation with the case of damage basically contains the following documents: insurance policy, certificate for the insured, medical documentation, heirs, etc. In case of serious injuries, loss of limbs, etc., depending on the injuries, the examination can be performed by a commission of authorized judicial experts or censors, according to the type of injury.

When reporting the accident, the insurance beneficiary is obliged to notify the insurer in writing and to obtain the necessary documents. Upon completion of the procedure for the calculation of the amount of compensation, a report is prepared, and the entire documentation the merits of the claim are determined. The assessor, based on the submitted documentation for damage, i.e. the amount of damage, determines compensation for damage. On the cover of the case, the appraiser or liquidator of the damage writes the amount of compensation for damage that should be paid to the insured if there is a basis for the claim for compensation.

### 2.3 *The manner of decision making and payment of costs*

Based on the established facts in the liquidation procedure, the claims liquidator makes a decision for resolving the damage. The decision is made in the form of a written notification to the damaged party, which is giving an order for payment of the damage. The notification must contain the decision for resolving the damage and the grounds on which the payment will be made, as well as the types of damages

that are rejected as unfounded. The notification should explain the facts due to which the damaged claim or some kind of damage was not recognized.

The liquidator also makes a computer record of the amount for payment of the damage. If the basis of compensation is not disputed, and the amount of compensation cannot be determined because the settlement, treatment of the injured party will take a long time, the liquidator of the damage may, at the request of the insured or the injured party, decide to pay advance or indisputable part. The payment of the damage needs to be made within the stipulated deadline.

### **3 A new model that is proposed for calculating the real costs arising from traffic accidents**

#### *3.1 Need to create a model*

In the Republic of North Macedonia, looking back from 25 to 30 years, on average, about 6000 traffic accidents occur annually, of which about 3000 accidents are with injured persons and about (from 150 to 200) accidents are fatal.

The system of insurance against the risk of including a vehicle in traffic, as well as the fee for use of roads in our country has not changed for decades, and it is a system of lump sum tax, which is paid at vehicle registration, as well as regardless of the intensity of use of the vehicle (mileage or amount of fuel consumed).

There is no doubt that the problem of realizing the costs of traffic accidents for many countries in the world with a high degree of motorization causes great headaches, and above all to insurance companies that seek to compensate as little as possible the damage caused to their policyholders - clients. On the other hand, the insured seek or have the desire to be compensated for all the damage caused, not only direct material damage, but also non-material damage such as: lost profit due to vehicle use, fear, pain, reduced life activity, resentment, pain due to a lost family member, close person, etc. From numerous faculties, institutions, institutes and individuals, no one so far in Republic of North Macedonia has not engaged in scientific research on the costs of traffic accidents and insurance against them as a risk. Everything that has been written about this issue in the Republic of North Macedonia comes down to annual reports of the police and insurance companies. This is one of the reasons to treat this issue more and a small step has been made in the research in this area, in order to propose a new model for calculating the insurance against traffic risk in general, and especially in road traffic.

#### *3.2 Defining the real costs of traffic accidents*

It is the most difficult to determine the damage caused by a traffic accident from the aspect of injured persons. In our society there is nothing more important than the life and health of people. Therefore, expressing the life of a person with monetary equivalent is not an appropriate measure, but still it is done both in our country and in the world.

The costs to be calculated would be the total losses from a traffic accident, which are incurred from the accident itself or are part of it. The total real economic costs of traffic accidents consist of:

- Damages from damage and destruction of a vehicle (costs for towing to a workshop, for repairs, reduced value of the vehicle), as well as lost profit due to not using the vehicle during the repair,
- Damage to the cargo, destroyed in a traffic accident (goods, luggage, etc.),
- Damage from road damage, buildings and other damage at the scene of the accident,
- Administrative costs (police, court and expert - expertise, etc.),
- Payment of pensions and expenses in the form of financial assistance to disabled people for work or the family of those killed in a car accident,

- Expenses of the victims (hospital expenses, rehabilitation expenses, disability, pain and fear as well as other expenses).

All the listed losses, which occur in the event of a traffic accident, can be grouped into two groups:

TA. *Material costs*,

TB. *Intangible costs*.

Therefore, the total cost of traffic accidents would be:

$$T = TA + TB$$

### 3.3 *Defining tangible and intangible costs*

Material costs incurred in traffic accidents consist of:

- The first group of material costs from damage or destruction of the vehicle, towing, repair, lost profit, we will denote them by Ta1.
- The days lost when not using the vehicle will be marked with Dn;
- The second group of material costs are the value of the goods (luggage, value of cargo, etc.), and they will be denoted by Ta2;
- The third group of material costs, which occur in case of damage to the road, road structures, fences, buildings and the same will be marked with Ta3.
- Intangible costs arising from traffic accidents are as follows: Costs for transporting the injured or killed from the scene to the hospital, treatment and rehabilitation, they will be marked with TB1;
- Expenses for compensation for the payment of pensions and expenses in the form of financial assistance to the disabled persons for work or the family of the persons killed in a traffic accident, they will be marked with TB2;
- Compensation costs for pain, fear, as well as funeral expenses, in case of an accident with a fatal outcome, and they will be marked with TB3;

However, when calculating the damages of the injured persons, it is necessary to differentiate the traffic accidents, the consequences of the same. Because the costs of the injured are not the same as the costs for the severely injured, especially when it comes to disabled people or the costs of the dead. Therefore, the damage per victim in the case of bodily injuries is:

$$P_l = n_1 C' + n_2 b + \frac{D}{30} n_2 \quad (\text{€})$$

Where is:

that n1- number of days of stay of the victims in the hospital (for bodily injuries it is taken a maximum of 7 days, while for severe injuries it is 27 days;

n2- lost working days due to inability of the injured person to work (in our country it is on average 4.5 days, and in this type of injuries, and for serious injuries it is 46 days;

C ' '- costs in the hospital for the stay of the victim per day in an appropriate place;

b - Average daily income of the victim

D - National income per capita.

However, in a traffic accident, there can also be people with severe bodily injuries, as well as killed in the same traffic accident. Therefore, damage per victim must be calculated for all types of injuries and especially for disabled people, as well as for accidents with fatal consequences.

It is a pity for one victim with severe bodily injuries:

$$Pt = n_1 C' + \frac{D}{30} n_2 + C'' + n_2 b \quad (\text{€})$$

Where:

$C'''$  - payment of allowances, pensions and other to the family of the deceased, which is

Approximately three average salaries per year.

Therefore, the total intangible costs are approximately:

$TB = TB_1 + TB_2 + TB_3$  that is,

$$TB = P_1 + P_t + P_i + P_s (\text{€})$$

#### 4 Conclusion

With the rapid modernization of production technology as well as to reduce the production of motor vehicles, it seems that the disease should be increased and analyzed due to traffic accidents and if damage is caused by them. According to European Commission reports on traffic safety, the number of accidents is increasing every year, and the union is not achieving its goal of reducing the number of victims and damages caused by traffic accidents. At the current rate, the death toll is rising. In addition, it is stated that the number of victims per million ranges from 50 to 60 people. In some countries this number is even higher, depending on the country. According to the given reports and researches, it can be noticed that the main reason for road safety are the three most important indicators:

- Driving speed,
- Seat belts, non-compliance with traffic rules and regulations,
- Alcohol

The European Union is making great efforts to investigate the causes and preventive measures to increase traffic safety as well as to repair the consequences of traffic accidents, that is to reduce costs, and to build the most appropriate model of insurance system that will compensate the costs incurred as a result of traffic accidents.



Therefore, we recommend in the future to the professionals and persons engaged in science in the field of traffic to put pressure on the institutions of the system, to invest funds in scientific research work in the field of traffic safety.

As a possible solution to the current problems in this area, a special contribution would be the research and clarification of the real costs caused by traffic accidents in the Republic of North Macedonia.

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