

THE COSTS OF ROAD ACCIDENTS IN POLAND

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Abstract:

The article describes the problem of road accidents in statistical terms. The costs of road accidents were presented in a measurable and non-measurable context. Total and unit costs have been discussed.

Keywords:

road accident, road traffic safety, costs of road accidents

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1. Road accidents in Poland and in the world - the context of the problem, groups of road users

Along with the intensive development of the automotive industry, the risk of a road accident increases. In Poland, the road safety analyses use definitions published in Ordinance No. 31 of the Police Commander in Chief of October 26, 2015 on the methods and forms of conducting sta-

A seriously injured person – it is a victim of an accident requiring hospital treatment, a slightly injured person - a person whose injuries do not require hospital treatment (a person who has suffered a health impairment that violates the functions of the organs of the body or has a health disorder for a period lasting not longer than 7 days, as determined by a doctor). A road collision (to which a value in terms of material loss will be assigned later in this article) - is a road accident involving only material losses [2].

A road accident may be the result of many factors: driver's error (failure to comply with road traffic regulations; excessive speed, consumption of alcohol, drugs or other substances, falling asleep, incorrect lane change, inattention, fatigue, etc.), error of another road traffic participant, sudden unforeseen situations or road conditions. The consequence of a road accident may be fatalities, seriously injured victims, slightly injured victims and material losses.

The latest data from the Police Headquarters shows that in 2021 there were 22,816 road accidents, resulting in the death of 2,245 people and 26,415 people were injured in the accidents, including 8,276 seriously [3].

The national road safety policy and the direction of actions taken are shaped by the National Road Safety Policy. The National Road Safety Program 2021-2030 presents the assumptions - zero fatalities on the road and the goals of reducing the annual number of fatalities by 50% by the 2030 (no more than 1,455 people) and reducing the annual number of seriously injured by 50% by the 2030 (no more than 5,317 people) [4]. The principles of the program are:

Table 1. Accidents, fatalities, injured and seriously injured in road accidents in Poland for the years 2010-2021

Year	Number of accidents	Fatalities	Injured	Seriously injured
2010	38 832	3 908	48 953	11 491
2011	40 069	4 189	49 506	12 585
2012	37 046	3 571	45 792	12 049
2013	35 847	3 357	44 059	11 672
2014	34 970	3 202	42 545	11 696
2015	32 967	2 938	39 778	11 200
2016	33 664	3 026	40 766	12 078
2017	32 760	2 831	39 466	11 103
2018	31 674	2 862	37 359	10 963
2019	30 288	2 909	35 477	10 633
2020	23 540	2 491	26 463	8 805
2021	22 816	2 245	26 415	8 276

Source: Polish Road Safety Observatory, observatoriumbrd.pl

tistics on the road incidents by the Police and Order No. 40 of the Police Commander in Chief of December 18, 2017 amending the ordinance on the methods and forms of conducting by the Police statistics on the road incidents [1].

The definition of a road accident according to the Act of 20 June 1997 - Road Traffic Law - is an event related to the traffic of vehicles on public roads, which resulted in the death or injury of people. A road accident fatality is defined as a person who died as a result of injuries on the spot or within 30 days. An injured person as a result of the road traffic accident is a person who has been injured and received medical attention.

- limitation of the consequences of errors,
- designing solutions friendly to all road users,
- improvement of all elements of the road transport safety system,
- common responsibility for the road traffic safety,
- promoting activities based on the latest knowledge and modern solutions,
- health prevention and sustainable development,
- safety as the highest priority.

The pillars of the National Program are: road safety management system, safe person, safe road, safe vehicle, rescue and post-accident care services.

The safest roads in the world are those in Europe, they have an advantage over all other regions of the world. In the European Union, in 2019, per million inhabitants, an average of 51 people died in road accidents, and in North America - 121. The EU's advantage in road safety is the result of multi-annual plans and implemented legal regulations. In its 2011 White Paper entitled "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system", published on 28 March 2011, the European Commission set 2050 as a deadline to move towards the "zero fatalities" target [5].

The next Decade of Action for the Road Traffic Safety in the years 2021-2030 was announced by the United Nations in 2020. Its objective is to reduce the number of fatalities in road accidents by 50% compared to 2020.

In the context of road accidents, it is extremely important to compare different groups of road users in terms of their share in the total number of fatalities and injuries. Data on fatalities arranged by the road user groups remains rather stable [7]. Passenger car drivers accounted for the largest group of fatalities - 46% of the total. Another group is pedestrians - 27%, motorcyclists - 10% and cyclists - 9%. Compared to other countries, according to IRTAD data (International Traffic Safety Data and Analysis Group), the percentage of killed unprotected road users (pedestrians, cyclists, motorcyclists and moped users) in Poland is relatively high, accounting for about 40% of the total (fatal and injured) road accidents victims. This is the most serious problem in road safety in Poland. In 2021, 4,755 accidents involving pedestrians (20.8% of the total) were recorded, in which 527 pedestrians (23.5% of the total) died, and 4,304 pedestrians were injured (16.3% of the total). Compared to 2020, the number of accidents involving pedestrians decreased by 480 people (-9.2%), the number of fatalities by 104 (-16.5%), and the number of injuries by 396 (-8.5%). In 2021, cyclists were involved in 3,513 road accidents, in which 185 cyclists were killed and 3,192 people were injured (3,179 bicycle drivers and 13 passengers). Compared to the previous year, the number of accidents involving cyclists decreased by 255 (-6.8%). In 2021, motorcyclists were involved in 2 050 road accidents, in which 207 motorcyclists and 8 of their passengers were killed, and 1 706 motorcyclists and 178 motorcycle passengers were injured. Compared to the previous year, the following numbers decreased: the number of accidents involving motorcyclists by 25 (-1.2%), the number of fatalities by 29 (-11.9%), with a slight increase in the number of injured by 5 (+0.3%) [3].

2. Measurable costs of road accidents in Europe, conclusions of the SafetyCube project

Every year, millions of people lose their lives in road accidents. The World Health Organization (WHO) notes that 1.35 million people worldwide die in car accidents each year, and about 20-50 million people are injured as a consequence. Road accidents are the most common cause of death or permanent disability of children and young people aged 5 - 29. It is estimated that road accidents account for approximately 3% of GDP, and up to 5% of GDP in low- and middle-income countries [6]. According to the organization, the costs associated with treating road accident victims alone on a global scale amount to approximately \$ 520 billion annually [7].

The socio-economic cost of road accidents - a large part of which is borne by the health sector - is estimated at around 2% of a given country's gross domestic product (GDP). For EU countries, this means around EUR 180 billion - twice the annual EU budget (2004). Road accidents are the most important category of external costs for transport in Europe: EUR 158 billion per year or 2.5-3.0% of GDP in 17 Member States.

Excellent data is provided by the report published in 2020 on the project of the European Commission and Horizon 2020 entitled: SafetyCube (Safety CaUsation, Benefits and Efficiency), aimed at innovative road safety decision support (DSS) that will enable policymakers and stakeholders to choose and implement the most appropriate strategies, measures and costs leading to a reduction in the number of casualties among the road users [8]. The authors of the publication divide the costs of accidents from a socio-economic perspective, in particular, in to the following:

- medical costs (e.g. costs of transport to a hospital, costs related to hospital treatment),
- costs related to production losses,
- human costs,
- costs related to damage to the property (mainly vehicles),
- administrative costs (e.g. police, fire brigade, insurance),
- other expenses (such as funeral expenses).

In accordance with international guidelines, medical costs, property damage costs and administrative costs should be calculated using the restitution cost method. The costs related to production loss should be calculated using the human capital approach, meaning that the loss of human productive capacity is estimated. The so-called "Willingness to repay" is generally recommended for estimating human costs, although other solutions have also been developed. For example, in Germany and Australia, human costs are calculated on the basis of financial compensation that is awarded to road accident victims or their relatives in lawsuits or under the law. Another approach is to deduct human costs from the premiums customers pay for life insurance or from public expenditure on improving (road) safety. These alternative approaches usually result in significantly lower values than those found in the research. The SafetyCube project recommends an individual approach to human cost estimation as it is theoretically the most sensible method, particularly for cost and benefit estimation, and is common practice in many countries [8].

Information on accident costs in European countries was collected using the Excel questionnaire. The data concerns the costs of: a road accident, a fatal victim, an injured victim, a seriously injured victim, the total costs of accidents in a given country, detailed costs (e.g. for health care). Data was obtained from 31 European countries out of 32 participating in the study and included in the analysis.

Claimed costs related to the fatality range from EUR 0.7 million per fatality in Slovakia to EUR 3.0 million in Austria, and are usually higher in Northwest Europe than in Southern and Eastern Europe. Declared costs for serious injuries range from € 28,000 in Latvia to € 959,000 in Estonia, while reported costs for minor injuries range from € 296 in Latvia to € 71,742 in Iceland. When comparing the cost of an injury to the cost of the fatalities, the cost of a serious injury appears to range from 2.5% to 34% of the cost of the fatalities, although in around three-quarters of countries this figure is between 10% and 20%. The costs of one slightly injured person range from 0.03% to 4.2% of the cost of the fatal victim. Total accident costs range from 0.4% to 4.1% of GDP, with no clear geographic pattern. Improved road safety performance should generally result in lower accident costs, but only a weak positive relationship was found between the fatality rate and costs in terms of percentages of GDP. Excluding damage to property or other accident severity levels and the lack of appropriate correction due to inadequate cost calculation may result in an underestimation of the total accident costs. Differences between countries are also due to methodological differences, in particular whether the so-called willingness to repay method is used. In the countries that use it, human costs account for a large proportion (34% to 91%) of the total accident costs. In the countries that use the alternative method, the share of human costs in total costs is much lower (less than 10%). Moreover, in most countries, the main costs are property damage and economic losses, while medical and administrative costs are relatively low [8].

The severity of injuries accounts for a large proportion of the total costs (on average 2.4 times the share of fatalities in the total costs), but varies widely from country to country. For countries reporting the severity of accidents, 7.4% to 55% of costs are fatalities, 14% to 77% are the cost of serious injuries, 1.9% to 34% of minor injuries, and 2.0% up to 55% of property damage. Possible explanations for this variability include differences in the definition of accident severity levels.

The authors estimate the cost of the fatalities at 2.3 million euros; including human costs (1.6 million euro) and losses to the economy (0.7 million euro). The cost of severe and minor injuries is estimated to be 13% and 1% of the cost of the fatality, respectively. Human costs are by far the top cost item for injuries as well. According to the authors of the SafetyCube project, the cost of road accidents for EU Member States is estimated at around EUR 270 billion, which corresponds to 1.8% of GDP. These are underestimated figures as many countries have declared a lowered number of casualties or accidents.

3. Measurable costs of road accidents in Poland

For many years, Agata Jażdżik-Osmólska, PhD, Eng. has been involved in researching the costs of road accidents in Poland. The last cost estimates of road accidents in Poland were made in 2018 [10]. In 2018, the social costs of all road incidents in Poland were estimated at PLN 56.6 billion, including: the costs of road accidents - PLN 44.9 billion, the costs of road collisions - PLN 11.7 billion. In total, in 2018 the costs of road accidents accounted for 2.7% of Polish GDP, including accident costs - 2.1% of GDP.

The Pandora cost valuation method was adopted. The method covers the valuation of total costs and unit costs of four categories of losses:

- unit cost of the fatal victim,
- unit cost of a seriously injured victim,
- unit cost of a slightly injured victim,
- and the unit cost of material loss.

4. Unmeasurable costs of road accidents in Poland

Internal costs

The unmeasurable costs of road accidents are an extremely broad research issue. They are divided into internal costs and external costs. Individual social losses (the so-called internal costs) include spheres of human life, which are exposed to the negative effects of road events and are incurred individually by individuals [11].

The following types of social losses of individual road events should be distinguished:

- the long-term feeling of grief and pain after the loss of loved ones due to their death,
- suffering of the victims as a result of their hospitalization and rehabilitation, both long-term, temporary and short-term,
- support, commitment and time offered to the victims by their relatives during their hospitalization and rehabilitation,
- depending on the need: short-term, temporary or long-term - temporary

Table 2. Costs of road accidents broken down by years [9]

Year	Cost of GDP	Total cost of road accidents
2012	1,6% GDP	29 372 482 000 PLN
2013	2,1% GDP	34 165 245 132 PLN
2014	2,81% GDP	34 757 855 078 PLN
2018	2,1% GDP	44 983 138 216 PLN

The estimate of unit costs consists of the valuation of the categories of elementary costs generated by road events, such as:

- costs of work by the police and rescue services,
- costs of prosecutorial and funeral services,
- hospitalization costs,
- costs of criminal proceedings,
- costs of compensation and restitution,
- material losses,
- the country's economic losses.

The largest share in the category of costs of road accidents and collisions in Poland in 2018, amounting to 58%, have production losses due to the death or indisposition of an employee at work. The second largest is the share of material losses (21%) and administrative and operational costs (17%). The remaining 4% are the costs of non-material losses and medical expenses. Unit costs of road accidents and collisions in 2018 amounted to: unit cost of a fatal victim - 2.4 million PLN; / unit cost of a seriously injured victim - 3.3 million PLN; / unit cost of slightly injured victim - 48.2 thousand PLN; / unit cost of a road accident - PLN 1.4 million PLN; / unit cost of a road collision - PLN 26.7 thousand PLN [10]. In conclusion, the main components of accident costs are:

- actual losses incurred as a result of property damage, rescue costs, medical care, rehabilitation,
- value of the lost production as a result of temporary inability to work, permanent loss of health or death,
- human costs (pain, suffering, reduction in quality of life).

Most often, real costs are used, which can be calculated objectively and may reflect the burden on society with the costs of road accidents.

- loss of earnings by people injured as a result of temporary hospitalization, or even permanent (long-term) loss of earnings by people with permanent incapacity to work,
- lowering the standard of living of the dependents of victims of accidents who died or are permanently incapable of working, with possible temporary and long-term effects,
- reducing the efficiency of work of relatives of the victims of road accidents who died or ended up permanently injured, during the long-term trauma following the loss of a loved one or their disability, as well as during hospitalization and rehabilitation, when relatives care for the injured,
- temporary or long-term home treatment and rehabilitation at home, which is costly and limits the mobility of family members of the affected,
- undergoing temporary or long-term psychological therapies by people injured as a result of road accidents, as well as their relatives, especially those whose family members died or were permanently mutilated for the rest of their lives as a result of road accidents,
- long-term/short-term time of reduced mobility of participants in accidents and collisions in the event of slight or complete damage to the vehicle,
- temporary or long-term losses of employers, as a result of also temporary/long-term inability of a qualified employee to work,
- losses of private insurers [11].

External costs

External costs are borne by the society. The general economic losses of the state are being limited only to road accidents, without a separate group of road collisions. Road accidents are the cause of short and long-term economic losses, depending on the type of accident and its severity. Sometimes the victim of an accident suffers its consequences throughout his life or is, for example, permanently incapable of work. This is linked to lost GDP and other tangible costs; payment of benefits in the form of accident

pensions, survivors' pensions for the victims' families. People involved in a road traffic accident sometimes also have to change their professional qualifications.

For the purposes of estimation, the costs of accidents should be broken down into costs that can be applied to the victims of accidents and the global costs of the accident (administrative costs, compensations paid, etc.). The costs related to the victims of accidents include, first of all, the costs of treatment, rehabilitation and specialist equipment. It is also the cost of adapting the injured person to a new life: changing the profession, adapting the home, or changing the means of transport. The costs related to the accident itself are the costs of the rescue action and remediation of the accident consequences, the administrative costs of the investigation and the costs of the damaged material property [11].

From the point of view of the state, external costs are of particular importance. It is they that constitute a measurable cost and have an impact on the burden on the national budget.

5. Summary

Any traffic system is very complex and can be dangerous to human health. Elements of this system include motor vehicles, roads and road users and their physical, social and economic environments. Making the traffic system less dangerous requires a "systems approach" - understood as the entire interaction between its elements and the designation of areas that need to be changed. In particular, it should be remembered that the human body is very susceptible to injury, as well as the fact that people make mistakes. A safe road traffic system is one that enables and compensates for human physical sensitivity and its fallibility [12].

Road safety is a shared responsibility. Reducing road risks requires commitment and informed decision-making by government, industry, NGOs and international agencies, with experts from a wide variety of disciplines including road engineers, vehicle designers, law enforcement officers, healthcare professionals and representatives of the community concerned.

Many road safety projects carried out at the Road Safety Centre of the Motor Transport Institute have proven that police and medical databases play an important role in planning and managing road safety. Collecting and analysing data from the public health care system allows to:

- identify accident risk factors,
- implement, monitor and evaluate the changes made,
- introduce appropriate prophylaxis, improve care and rehabilitation of the injured,
- highlight importance of the problem of road safety and accidents.

Road accidents are predictable and preventable. Many high-income countries have shown a significant reduction in the number of accidents and casualties in recent years. This has been achieved, among the others, by adopting a systems approach to road safety that emphasizes the environment, vehicle and road user interactions, not just changing the behaviour of road users. While solutions for low and middle income countries may differ from those with a longer automotive history, some basic road safety principles are the same: for example, good road design and proper traffic management, speed control, seat belt compliance and enforcement of alcohol limits. The challenge is to adapt and evaluate existing solutions or create new solutions in low and middle income countries [12].

The consequences of a road accident are borne not only by the person involved in it; it is also a heavy and tragic physical as well as mental burden for their families, friends and community. Healthcare facilities and their often modest budgets bear enormous costs for road accident survivors.

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