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ROADIDEA **Session**

The Effects of Severe Weather Conditions on Road Safety in Hungary

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After giving an overview about the Hungarian road safety situation and climatic conditions the authors analyze the relationships between road weather characteristics and accident circumstances. The findings of the paper could be used in order to improve the efficiency of the accident prevention under severe weather conditions.

Road traffic and safety situation in Hungary

Table 1.

Year	Number of Fatal+Serious accidents (F+S)	Killed persons	Level of motorization (Vehicles/10^3 inhabitants)	Traffic performance (Vehicle.km 10^9) (P)
1990	13923	2432	240	24,0
1995	9152	1589	275	27,5
2000	7452	1200	284	28,4
2005	8149	1278	345	34,5
2010*	6500	900	398	39,8

*estimated

(Persons killed: persons died within 30 days as a result of the accident, persons seriously injured: persons sustained injuries healing beyond 8 days.)

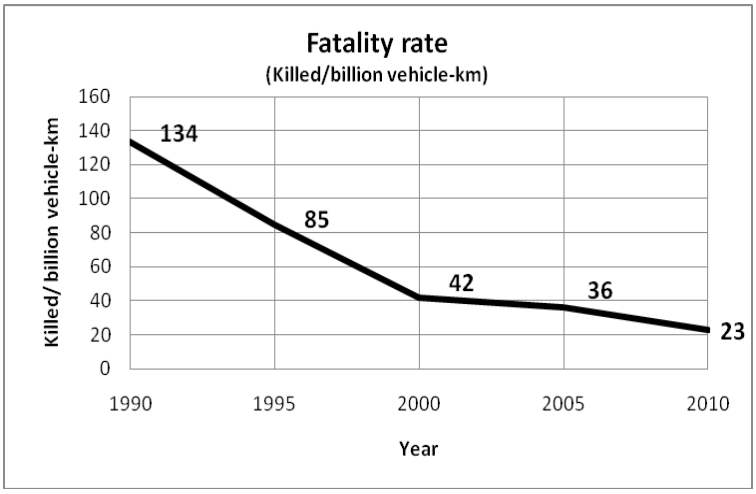

Figure 1.

Although the number of vehicle kilometres are only estimated in the Fig. 1, it can be seen clearly based on other indicators too, that the Hungarian road safety situation improved significantly in recent years.

For example the number of fatalities was below 1000 in 2008, first time since the introduction of accident statistics in Hungary.

Main characteristics of the Hungarian climate circumstances.

Hungary has a temperate continental climate that is influenced by three main factors: the Eastern-European continental, the Western-European oceanic and the Mediterranean influence.
There are substantial differences among the average temperatures of the four seasons. Usually July is the hottest month (average temperature 23,2 ^{0} C) and January the coldest (-1,3^0) in Hungary. The daily temperature fluctuation is quite high. The annual average temperature is about 12^0 C, the maximum is 38^0 C, the minimum is around 10^0 C.
Spring starts in early April and is accompanied by lots of showers. The summers are dry and warm. Autumns are cool, foggy and rainy. Winters are relativly short, moderately cold and usually dry, but sometimes sunny. The little snow the city gets usually disappears after a few days.
The yearly rainfall is about 420 mm that consist of two stronger (early summer and autumn)and two dryer periods (middle of winter and early autumn).
Sunny hours/year are between 1900 and 2055. The annual average wind speed is 2.4 m/sec

The graph shows the average temperatures in Budapest throughout the year

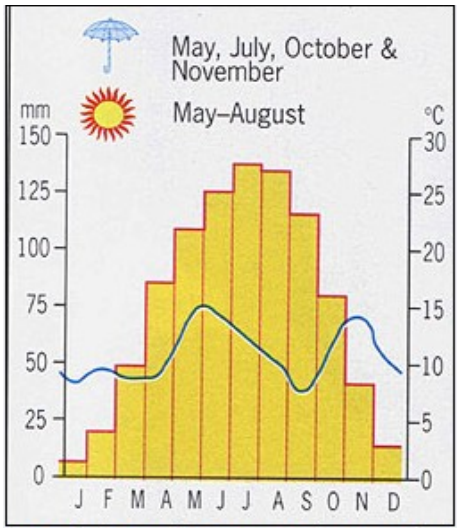

Figure 2.

Accidents at severe weather conditions

In the Figure 3 the percentage of accidents occurred at normal and severe weather conditions can be seen. The yearly distribution of the two lines (all cases and cases occurred under severe weather conditions) is almost the same. It means that the trend is similar except the period between 2006 and 2007: here the trend of all accidents is increasing and the trend the fatal ones is decreasing. The percentage of fatal accidents is higher than those of all accidents in all investigated periods. It means that the weather conditions have stronger influence on the number of fatal accidents than those of all accidents.

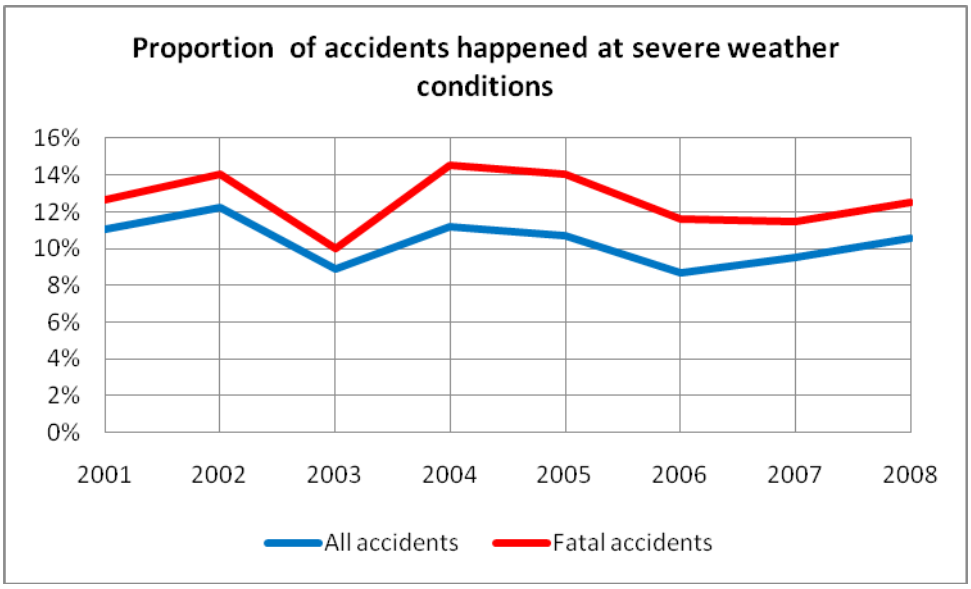

Figure 3.

Foggy weather and accidents.

The foggy weather influences the movement of means of transportations directed by people unfavourably primarily due to the reduction of the distance of sights. An essential aim of the warning system informing the road users on the weather conditions is to avoid accidents by calling the divers' attention and assuring the most detailed and exact information as possible. Some main features of the road accidents (PIA) causing personal injuries and having occurred in the public roads within Hungary between 2001-2008 are summarized briefly. The information relevant to the weather are from the Police Accident Report Forms.

The number and severity of the accidents

Altogether 160 000 accidents causing personal injuries occurred in Hungary during 8 years between 2001-2008, roughly 10% thereof happened under adverse weather conditions (rain, snowing, fog, storm, shower) and 1.6% of all accidents causing personal injuries took place in foggy weather. Thus the number of cases happened in foggy weather is very low, maybe it would not give reasons for the installation of the costly traffic management systems and other interventions by itself. However, the average severity of the accidents taking place in foggy weather is definitely greater than in case of other accidents, but then it give reasons for outstanding attention in the traffic management in foggy weather and information supply to those participating in the traffic. In the last 8 years 5.6% of all accidents causing personal injuries were fatal in the Hungarian roads, but at the same time the same ratio in case of the accidents taking place in fog is 8.4%.

Date of accidents taking place in foggy weather

Of course, the foggy accidents happened when it was foggy, this information is analysed in accordance with the police report. The fog characterizes the winter months in Hungary. It can be seen in Figure 4. how the number of accidents causing personal injuries and taking place annually is divided per the months of the year. The monthly distribution of the accidents taking place under favourable weather conditions primarily depends on the seasonality of the traffic volume, more accidents happen due to the heavier traffic in the summer months. The distribution of the accidents happened in foggy weather depends on the occurrence of foggy periods, nearly a half of these accidents occurred in Hungary in December and January between 2001-2008.

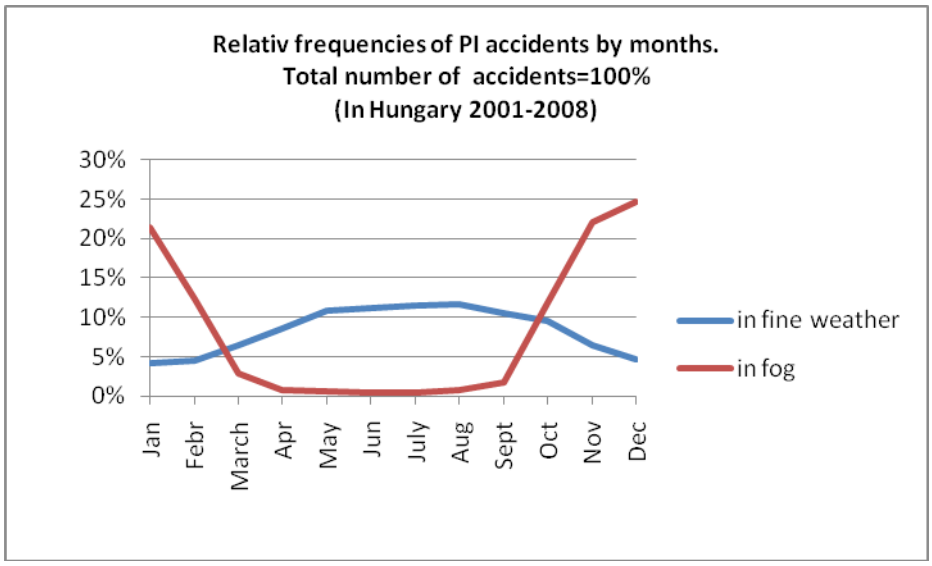

Figure 4.

Accidents by the hours of the day.

It can be observed in Figure 5. that the accidents happened under favourable weather conditions occur most often in the afternoon hours (4.00 – 6.00 p.m), of course, it is influcenced by daily seasonality of the traffic. However, the accidents taking place in foggy weather happened most often in the morning traffic "rush hour" around 7.00 a.m. In the winter months it is dark at that time and the limited visibility due to the fog jointly often cause accidents. The curve of relative frequency of the fog-accidents shows increase in the afternoon period, however, it is a significantly smaller "peak" than that one in the morning. This fact is of interest from the point of view of the operation of the system warning of the fog and wording the "messages".

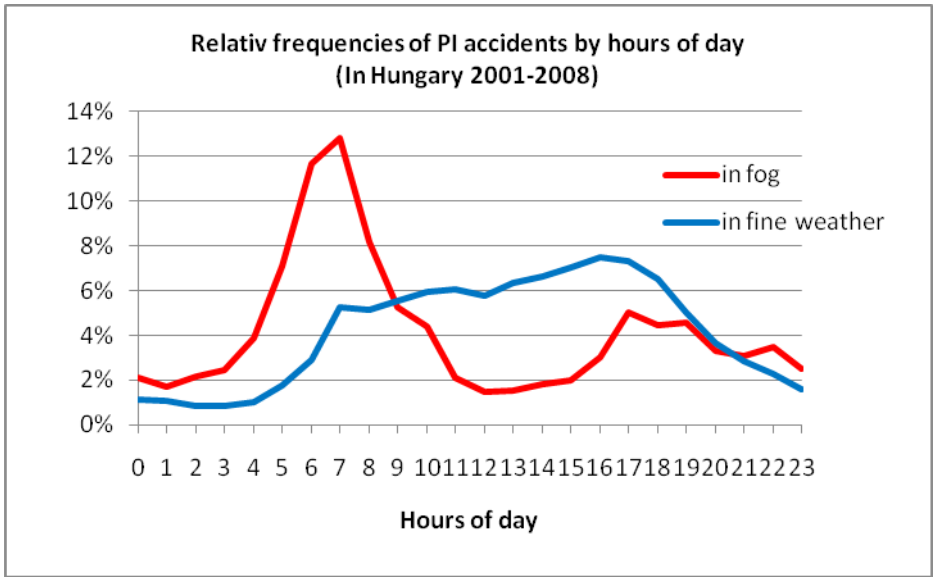

Figure 5.

Types of PI accidents taking place in foggy weather

In Table 2. the frequency of occurence of the most important accident types are illustrated in accordance with 8 years' data of accidents causing personal injuries in Hungary.

Table 2.

Accident type	relative frequency (%) (Accidents/all accidents)	
	in foggy weather	in fine weather
Rear-end collisions	11%	12%
Head-on collisions	17%	7%
Single-vehicle crashes	29%	16%
Accidents at junctions	9%	19%
Others	*34%*	*46%*

The statistical data - in a slightly surprising way – show that the rear-end accidents occur with nearly the same frequency in foggy weather as in favourable weather, although these cases are called typical "fog accidents". However, it is a fact that the so-called pile-up accidents typically occur in foggy weather, their avoidance is one of the essential aims of the traffic management systems.
However, in case of two types of accidents significant differences are shown in the frequencies. Usually the frequency of the head-on accidents with the most serious outcome is significantly higher in foggy weather than with favourable visibility (17%-7%), and the relative frequency of single-vehicle accidents is remarkably higher in fog (29%-16%). Both types of accidents are closely correlated with speed and distance of sight, the attention calling used by the system warning of fog has to primarily be focused on the selection of the safe speed.

Table 3

Accident causer	Relative frequency (%) (Accidents/all accidents)	
	in foggy weather	in fine weather
motorbike	0,4%	5%
passenger car	72%	60%
truck	12%	8%
bicycle	4%	11%
pedestrian	5%	8%
Others	*6,6%*	*8%*

The data in Table 3. show that the motorbike riders are rarely among the causers of accidents taking place in foggy weather (0.4%), but nearly three-quarters of such accidents (72%) are caused by the passenger car drivers. The truck drivers cause 12% of the accidents taking place in fog, while in fine weather this ratio is only 8%. Thus the target groups of the warning related to fog are primarily the passenger car- and truck drivers.

Accidents inside/outside residential areas

68% of all accidents causing personal injuries in Hungary between 2001-2008 happened in built-up areas, and 32% in the so-called external sections of the roads (outside built-up areas). A greater part of the cases occurring in foggy weather (62%), however, occurred outside built up areas. Only 5% thereof happened in motorways, most of them took place on main roads and after on the secondary roads.

Table 4

Accidents on roads outside built-up areas (In Hungary 2001-2008)	Relative frequency % (Accidents/all accidents)	
	in foggy weather	in fine weather
Motorways	5%	7%
Main roads	48%	48%
Secondary roads	38%	33%
Others	*9%*	*12%*

ROADIDEA „Theoretical pilot"

The Fog monitoring and alert system pilot planned in the frame of ROADIDEA project is possibly implemented in Venice region in the Po Valley area in Northern Italy. In this area the fog can develop very quickly and create serious problems for traffic. The results of the pilot will be useful in all regions where fog is a natural typical phenomenon.
The main goal of the „Fog" pilot is to set up a system which allows possibly large end user groups to access visibility information in real time as an important element for their pretravel or on-route decision making process.

The main data sources comprise:
• Visibility data from visibilimeters;
• Meteosat-9 satellite products;
• Temperature and wind profilers;
• Traditional meteorological surface observations.

In the course of the project ARPAV will evaluate whether it is feasible and beneficial to add data sources like:
• Web cams;
• Reports from traffic participants.

Partners or stakeholders of the ROADIDEA „Fog Warning System" are: ARPAV, VTT, FMI, RODS, Destia, Motorway Agencies.

Sources:
www. ksh.hu (Central Statistical Office in Hungary)
www.roadidea.eu (Documents of ROADIDEA project)