

# The Research of the Number of Accidents with the Agriculture and Forestry Tractors in the Europe and the Main Reasons for those Accidents

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*The agriculture and forestry tractors represent big potential danger for traffic and working accident. Because of their construction they have very high centre of gravity and are therefore very unstable vehicle. In the Republic of Slovenia (RS) from 1981 to 2005 died 773 peoples. Fortunately the number of victims is less every year. The main reason for accidents with the agriculture and forestry tractors is overturning. This is the case in the RS as well as in other countries. The number of deaths in accidents with the agriculture and forestry tractors was acquired with the help of foreign type-approval and registration bodies.*

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## 1 GENERALLY ABOUT ACCIDENTS

In the RS as in every other developed country due to the high standard of living the number of motor vehicles is growing all the time. This is the cause of several difficulties. Our surrounding is polluted with toxic gases and noise, the traffic is increasingly dense and last but not at least there are also a lot of traffic accidents. Causes of accidents are various but the majorities are due to unsuitable speed and alcohol. It is not possible to prohibit selling alcohol and it is also impossible to limit all the vehicles to an appropriate (i.e. safety) speed. Therefore we have to make changes in other fields. In addition to building better roads we can also improve the safety of motor vehicles. For these reason experts all around the world carry out investigations, perform tests on vehicles and their parts and then write the technical prescriptions and legislation for motor vehicles to make them better and safer. The legislation that regulates vehicles before their registration or before their giving into service is the legislation in the area of conformity assessment of motor vehicles. Beside this there are also the rules that regulate the equipment of the vehicles and the rules for vehicles in use (rules on technical inspections of the vehicles).

However, these rules are not valid only for road motor vehicles and their trailers but also for agriculture and forestry tractors. These kinds of vehicles are in traffic on roads and also at work

on fields and in forests. Accidents with these vehicles are very often and because of various reasons.

These kinds of vehicles are nowadays present on almost every farm in the Slovenia or in the world. According to the statistical data is the Slovenia with 116 tractors on 100 farms between the states with highly developed agriculture (Portugal 51, Italy 59, Austria 132, France 158, Great Britain 205). According to the number of tractors on ha of area that is in Slovenia 0.25 tractor/ha, we are even ahead of EU Member States (France 0.08, Austria 0.10).

In accidents with agriculture and forestry tractors similar to other motor vehicles every year a lot of drivers or their attendees are killed. These kind of vehicles are in use on public roads as well as on macadamized roads and at work on fields. Therefore the accident could happen anywhere. On public roads is a lot of various traffic and tractors which are proportionally slow vehicles are therefore often in dangerous. Even worse is with their use outside public roads where the driving surface is not smooth and flat.

We divide accidents with agriculture and forestry tractors on traffic accidents and working accidents. Traffic accidents occurs when the tractor is on public roads while working accidents are those that occurs at work on farm, field, meadow, forest, ...

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## 2 GENERALLY ABOUT REASONS FOR ACCIDENTS

There are a lot of reasons for the accidents. We could divide them on those that are related to:

- the driver (inexperience, alcohol, incorrect reaction of the driver ...),
- the tractor (technical condition of the vehicle, maintenance ...),
- the driving conditions (slippery driving surface, bad weather conditions ...).

The most frequent reason for accidents in agriculture and forestry is unprofessional use (driving of the tractor with inappropriate technique and speed on inclined driving surface, overturning ...) or unprofessional maintenance (various repairing or interventions, replacement of the pneumatic tyres, filling the fuel ...). The correct maintenance of the tractor stability is in the literature mentioned as a factor of eliminating various accidents and risks that could happened in the case of instability of the tractor and overturning around longitudinal or transversal axis.

Accidents that happened because of overturning of tractors represent about 40% of all accidents with tractors. On uneven surfaces is tractor very unstable vehicle that because of its construction overturn fast. That is because the tractor has relatively high centre of gravity, short distance between axles and short wheelbase. The stability of the tractor (static and dynamic) is changing due to acting of various reasons: slope and characteristic of the driving surface, inappropriate speed according to the conditions, skidding of the driving wheels, the size of the force on pulling rode and fast changes of movement of the tractor like standstill – driving, driving – inappropriate stopping.

Although the producers build more and more safer tractors, they cannot build a tractor that could recognise the dangerous situation. With safety arcs or cabins and safety belts the number of victims is reducing but with the development of new tractors also their capabilities are higher and higher. Overturning could happen because of too fast driving according to the driving conditions, sudden obstacles on the road (rocks, holes, ...), driving over canals, pushes by towing and also inappropriate use of front loading devices.

The research about the reasons for accidents was done in [1] and [2]. It was found

that the main reasons for traffic accidents with agriculture and forestry tractors were:

- Unsuitable speed (19%); According to the research unsuitable speed is the most important reason for appearance of accidents. Driving conditions (day, night, dry, wet, ice ...) are changing all the time so the driver has to take this into consideration to avoid accidents.
- Consideration (or non-consideration) of having precedence when driving through crossroads (14.9%). This reason for accidents is very connected with the psychophysical condition of the driver and the amount of driving experience.
- Driving on wrong the side of the road or in the opposite direction (13.5%). According to this reason it appears that drivers of tractors are very often wilfully exposed to potential risks.
- Psychophysical condition of the driver (15%). Among these reasons for more than one tenth of all accidents is driving under the influence of alcohol. Other reasons are tiredness, falling asleep and carelessness.
- Technical conditions of the vehicles (4.9%). This reason is the responsibility of the driver himself as a user.

Other research shows that more than 70% of all accidents with forestry and agriculture tractors happened on local roads and more than 21% on regional roads. This fact shows us the specific use of this kind of vehicles (mostly in the countryside).

Most of victims in such accidents are between 35 and 54 years age. It was found that main reasons for these accidents are [2]:

- bad estimating of the field, when the tractor slipped, overturned and crushed the driver. That reason was especially fatal for tractors without a safety arch or a cabin.
- unsuitable speed,
- wrong selection of the gear,
- too much load on the trailer,
- driving on the edge of the road or field,
- incaution of the driver,
- bad technical conditions of the vehicles.

The main faults were on light signalling devices, steering, tyres and on braking systems.

In the study [12] was found that in Ontario 244 people died as a result of tractor-related accidents between 1980 and 1994.

Table 1: Data about deaths in traffic accidents with agriculture and forestry tractors

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Slovenia	18	8	11	12	13	8	6	9	7	6	5	10	4	4	9	2
Finland	-	2	7	3	1	5	5	4	1	3	4	2	2	3	1	0
Austria	-	24	13	18	20	20	15	7	13	12	19	15	12	10	7	8
Netherlands	-	7	1	5	3	1	2	2	2	4	3	1	2	5	5	5
Sweden	-	5	4	2	1	5	0	3	3	6	4	0	3	2	5	1
Germany	-	-	115	112	94	107	134	112	101	106	95	96	104	110	87	-
Luxemburg	-	0	0	0	0	0	0	1	1	0	2	0	0	0	0	0
Great Britain	-	2	2	2	0	0	1	1	1	2	7	3	1	11	7	0
Portugal	-	57	58	55	36	38	36	35	33	30	38	32	31	26	35	33
Estonia	32	23	12	14	17	9	4	4	9	1	2	7	4	2	-	2
Latvia	-	-	-	-	-	14	7	12	15	10	7	10	9	11	10	-
Poland	175	123	115	111	93	98	68	84	82	72	72	62	47	61	57	67
Switzerland	-	-	-	-	-	-	27	26	26	24	28	23	20	25	18	13
Serbia	107	94	80	69	74	66	72	106	81	55	58	-	-	-	-	-
Belgium	0	4	2	1	2	4	3	2	3	4	5	0	1	2	3	1
Danmark	-	3	3	3	4	2	0	0	3	2	3	1	0	0	0	3
France	-	43	37	28	32	32	36	35	22	20	26	12	20	25	13	12
Greece	-	114	93	79	99	81	44	80	61	71	54	72	43	46	37	26
Italy	-	51	40	42	47	30	38	31	23	38	28	24	23	24	23	23
Spain	-	43	40	23	26	30	36	33	30	32	35	28	16	23	40	26
Croatia	-	-	-	-	-	-	20	14	8	3	10	13	14	8	10	13

For more than half of them the cause was overturning the tractor to the side or the rear. Among other causes they quote also touches with rotating power takeoff (PTO) shafts, running of the tractor into objects, slipping and falling by driving up or down ...

### 3 OBTAINING THE DATA

Most of the data about the responsible bodies for agriculture and forestry tractors and the number of deaths was gathered with the inquiry. Questions were sent to type-approval and registration authorities or statistical institutions to the other EU Member States. A lot of data for the most of EU Member States was gathered with this approach. Some statistical data was acquired also from the EU data base CARE (Community database on accidents on the roads in Europe) that is on web.

### 4 THE OVERVIEW OF CAUSES

#### 4.1 Causes in Slovenia

In Slovenia 758 people died as a result of tractor traffic and working accidents between

1981 and 2002, mainly tractor drivers and their passengers on tractor or its trailer or attachments. Most accidents (over 75%) happened because of the overturning of the tractor that then buries the driver or the passenger. For many years were the consequences of traffic accidents much badly than those at work. But in the recent years is number of deaths at work significant greater than those on traffic.

Serious concern is the fact that the circumstances which causes the most badly accidents with tractors is equal every year. After the implementation of the Road traffic safety act (from 1982) that prescribed that all tractors, placed on the market from 1st January 1984 have to be equipped with the safety arc or the cabin, and all tractors in use have to be equipped with the safety arc or the cabin until 1st January 1986, the number of deaths in traffic accidents with the tractor was reduced. However for the other tractors those are not registered these safety arcs or cabins are not obligatory and therefore the number of deaths in working accidents was not reduced. Most of the tractors that were involved in worst accidents were without the safety arc or cabin and in many cases not properly technically equipped.

Based on reports and notes about working accidents we were trying to find some the most frequent circumstances or causes causing the accident. In many times this was a difficult task, because there were a lot of various factors that contribute the overturning of the tractor that is the most common reason for deaths of tractor drivers. Most of the tractor drivers lost his life specially because of direct overturning of the tractor that is consequence of three circumstances. The most reasons for overturning are incautious at driving over the edge, bad estimation of the slope and incorrect gear at driving downhill, overloading of the trailer or unsuitable brakes on the trailer that push the tractor and overturn it. The problem of choosing the incorrect gear at driving downhill occurred in the past (nowadays only at technologically obsolete tractors) where transmissions gears were not synchronised and where it was impossible to change to a lower gear. Also the examples that the trailer pushed the tractor were typical in the past when tractors were lighter. Nowadays tractors are heavier but also more powerful and therefore drivers load them more and this also lead to the accident. Altogether is not regarding the basic circumstances for accidents in 75% of accidents the overturning the reason for bad injury or deaths.

The data about the number of deaths in accidents with agriculture and forestry tractors divided by reasons for accidents were obtained on the Ministry of the interior. In these data there are some difficulties. First, by years the structure of the database for accidents were changing and with this development also the distribution by causes was changing by the number and by the content. By years the number of causes was increasing. The second problem that occurs here is the cause named "other". In this rubric was installed a big number of accidents (in the period 2002 – 2005 almost 47%), that a little bit spoil the picture of distribution of accidents by causes. The most likely is this the inconsequentiality of the police at the evaluation of the causes for accidents and for not enough of the attention for the accidents respectively. This confirms also the comparison of the reports of the accidents that are written by the Slovene police officers and those written by the Dutch officers. In the Netherlands is every such report like an expertise with very accurate description of the situation and the

research of the causes for the accident while is in the Slovenia very short document.

The most accident happen when the driver bad estimate the driving surface he drives or work on and therefore too big leaning happen the slip and finally overturning of the tractor. Slips occurs especially on wet and soaked driving surface or on dry grass by haymaking.

Second often circumstance is overturning of the tractor caused by incautious driving on edges of meadows, fields and forests where not hardened driving surface do not hold out the weight of the tractor or the drivers drive over steep edge. Especially in last few years there were a lot of accidents with deaths caused by overturning of the tractor over the edge of the road or at driving backwards. At these overturnings there is no other circumstances, high speed or heavy trailers the appropriate safety cabin would reliably protect the driver of the tractor.

Third often circumstance is overturning of the tractor caused by too fast driving or inappropriate choose of the gear or overloading of the trailer that caused that driver could not stop the tractor. Drivers do not take into consideration that in many tractors while driving from the hill is not possible to change to lower gear because they could not stop the tractor. Reasons for overturning are also on inappropriate attaching of the trailer or working machine to the tractor when driving up to the hill the trailer because of the too high connecting point lift the front part of the tractor and overturn it back.

#### **4.2 Causes in Some other European Countries**

In Germany there is only for 20% of all deaths with agriculture and forestry tractors reason on turning, starting or breaking the tractor. These are of course that circumstances in tractor driving that the possibility of overturning is the highest. We could see hear the influence of the technical legislation that was in use already in year 1910 and that reached that only technical proper and safe tractors were in use. In United Kingdom the overturning and hitting with the vehicle represents 20% of all accidents with deaths. This is the biggest percentage of the accidents with deaths.

Table 2: *Reasons and circumstances that causes the accidents between the tractor drivers and others in traffic in Slovenia (period 1986 – 2002)*

year	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	SUM
reason	deaths																	
incautious driving	4	3	1	2	0	0	2	2	4	4	0	1	5	5	5	4	1	43
bad estimation of the surface, slip - overturning	3	5	5	6	5	4	2	9	6	3	2	3	7	4	4	2	4	74
driving over the edge - overturning	2	1	5	2	4	3	9	5	7	1	1	6	5	8	4	3	0	66
incorrect gear, speed	4	4	3	8	2	3	3	3	1	3	1	1	1	3	3	4	0	47
jump on moving tractor	0	0	1	2	1	0	2	1	1	1	2	4	1	0	3	0	1	20
fall from the tractor or trailer	0	1	0	2	1	1	0	0	1	2	3	1	1	1	1	2	1	18
unprotected connectors and shaft	0	0	1	0	2	3	1	0	1	0	2	3	0	0	2	1	3	19
other	2	2	0	1	1	3	0	1	6	0	1	2	3	1	3	1	5	32

In Portugal is 34.5% of traffic accidents with agriculture and forestry tractors caused by too high speed or by changing the direction of the driving. These are again those circumstances in tractor driving that the possibility of overturning is the highest.

In Switzerland 989 people died as a result of tractor traffic accidents between 1976 and 2005, and 519 of them because of overturning. These accidents represent 52.4 % of all deaths that is understandable according to the geographic structure of the country despite of long use of the legislation on this field.

In Serbia is the tractor first and the biggest reason for accidents on farms and causes are at:

- non professional use (driving the tractor with not correct technique and speed on slope surface, overturning, ...),
- non professional maintenance (various repairing or interventions, changing of wheels, filling with the gasoline, ...).

The overturning of the tractor is the reason for 40% of all accidents with tractors.

## 5 FINAL CONCLUSIONS

Based on written we could establish that the overturning of the tractor is the most often reason for accident with agriculture or forestry tractor in road traffic. In many of the studies is this reason on the first place. Similar result gives us also the research studies in various countries that we obtained the data. Therefore we could conclude that if we would like to do the traffic and work with these vehicles safer and prevent unnecessary deaths we have to work especially on two areas.

On area of agriculture or forestry tractors is necessary to act in a direction that these vehicles become safer. Regarding conformity assessment of tractors and prescriptions for offering to the market a lot is already done because the type approval prescriptions for safety constructions (the roll-over protection structures) and for safety belts for drivers are already in place. Furthermore there is necessary to assure that the roll-over protection structures for

Table 3: *Reasons and circumstances that causes the accidents between the tractor drivers and others in traffic in Slovenia (period 2003 - 2005)*

	sum	2003	2004	2005
sum	51	18	22	11
alcohol, drugs	1	0	0	1
incorrect side / direction of driving	4	1	2	1
abnormality on the tractor	1	0	1	0
incorrectnes of the pedestrian	1	1	0	0
inappropriate speed	5	1	4	0
unconsideration of rules	6	2	1	3
unusing of protectiv equipment	4	0	3	1
movement of the tractor	1	0	1	0
other	24	11	9	4
rest	3	1	1	1
unknown	1	1	0	0

Table 4: *Reasons and circumstances that causes the accidents between the tractor drivers and others in traffic in Slovenia (period 2005 – 2006)*

traffic accidents	reason for traffic accident	sum			2005			2006		
		sum	death result	personal injury	sum	death result	personal injury	sum	death result	personal injury
with at least 1 causer that is	sum	132	10	122	67	6	61	65	4	61
the tractor driver	incorrect side / direction of the driving	8	-	8	5	-	5	3	-	3
	inappropriate overtaking	3	-	3	1	-	1	2	-	2
	irregularity on the road	1	-	1	1	-	1	-	-	-
	irregularity on the load	4	-	4	3	-	3	1	-	1
	inappropriate speed	5	-	5	3	-	3	2	-	2
	unconsideration of the rules of the priority	24	2	22	9	1	8	15	1	14
	inappropriate safety distance	2	-	2	2	-	2	-	-	-
	movement of the vehicle	17	-	17	9	-	9	8	-	8
	psychophysical condition of the causer	31	8	23	21	5	16	10	3	7
	inexperience of the causer	22	-	22	6	-	6	16	-	16
	other	15	-	15	7	-	7	8	-	8
with at least 1 participant that is tractor	sum	200	10	190	107	6	101	93	4	89
	incorrect side /	15	-	15	9	-	9	6	-	6

driver	direction of the driving	12	-	12	7	-	7	5	-	5
	inappropriate overtaking	4	-	4	3	-	3	1	-	1
	irregularity on the load	19	-	19	11	-	11	8	-	8
	inappropriate speed	25	1	24	10	1	9	15	-	15
	unconsideration of the rules of the priority	6	-	6	4	-	4	2	-	2
	inappropriate safety distance	45	9	36	31	5	26	14	4	10
	psychophysical condition of the causer	37	-	37	12	-	12	25	-	25
		19	-	19	10	-	10	9	-	9

protecting drivers will be mounted also on the old tractors that are still in use. This could be assured with the prescriptions on the obligatory equipment for these vehicles and control on periodical technical inspections of the tractors. Type-approval legislation also regulate other parts of the tractor that contribute to the higher safety. The example of choosing the incorrect gear at driving downhill has been solved with the prescription that all transmission gears have to be synchronised. With the comparison between countries is obviously that in those countries where the legislation is in use for a long period also the number of deaths in accidents with such vehicles is lower. Moreover it is also possible to ensure with some constructional solutions that tractors will be also in exceptional situations still enough stable. These are various solutions from simple with additional weights to constructions for moving weights and modifications of the wheel suspensions.

Another area is of course the area of drivers. They have to be well educated that will know what is the proper use of these vehicles, where are their limits of use and how to recognise the moments where is only one step to the tragedy. And this step is very short because the studies shows us that the tractor could overturn when it is lifted for an angle of  $75^\circ$ . This angle is known as a point of no return. This angle could be reached already in 0.75 seconds. And this is in any case the time in which the driver could not react.

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