CITA Webinar

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MINISTRY OF TRANSPORT AND CONSTRUCTION OF THE SLOVAK REPUBLIC

Effect of Periodic Technical Inspections of Vehicles on Traffic Accidents in the Slovak Republic (Part I.)

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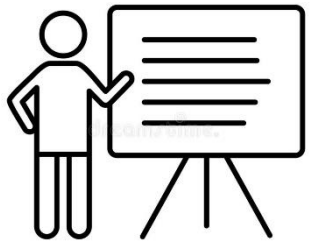
Aim of the study

Search for links between the PTI and traffic accidents by technical defects of vehicle in the Slovak Republic.

Based on these links, it is sought to assess the justification for PTI regarding the road safety.

For this purpose, statistical data on traffic accidents, caused by technical defects of vehicle as well as data concerning PTI carried out were examined.

Link to the article



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Presentation outline

- Issue of effect of technical defects of vehicles and PTI on causes of the traffic accidents in the light of the results of various studies and research projects

- Analysis of data on traffic accidents by technical defects of vehicles in the Slovak Republic

- Examination of traffic accidents by technical defects of vehicles in terms of their temporal distribution during the period of validity of the technical inspection and the age of the vehicles

- Correlation of results of vehicles' technical inspections with traffic accidents by technical defects of vehicles

- Conclusion and results

Introduction

Road traffic safety is a complex of phenomena, that depend on many factors and interactions.

Periodical technical inspections carried out by PTI stations

The main task of PTI stations is remove from road traffic temporarily roadworthy and not roadworthy vehicles, i.e. in a condition that threatens the health, lives and property of citizens, as well as the environment.

- the task of the state is to protect the lives and property of citizens,
- every civilized state is interested in ensuring that vehicles in traffic do not endanger road safety and the environment,
- this is related to the introduction of the obligation to periodical technical inspections of vehicles and measure emissions at PTI throughout the EU

PTI improves road safety

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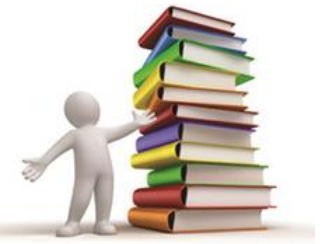
Fundamental questions

Can PTI affect the traffic accidents?

Can it be measured?



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Word studies, research and publications

- **the direct and indirect** influence of technical vehicle defects on the causes of traffic accidents,

- **comparison of states with** the obligation of periodical technical inspection of vehicles with states **without** this obligation,

- **comparison** of states **before** the introduction of the obligation of periodical technical inspection of vehicles and **after** the introduction of this obligation,

- **comparison** of states **after the abolition of the obligation** of periodical technical inspection of vehicles,

- **a comparison of the accident rate of vehicles** that **have been** subject to periodical technical inspections with vehicles that **have not been** subjected to these inspections within the jurisdiction of the same state.

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Word studies, research and publications

Percentage of vehicles with technical defects that directly caused the traffic accident

Study	Share
James Fazzalaro (2007), USA	**1 %**
Asander (1992) lit. review	**23 %** (direct causes or increasing damage or injury) (Finland) **7-9 %** (major causal role, a contributing cause, or by increasing the consequences of the accident) (Denmark)
RACQ (1990) lit. review	**5 %**
Rompe & Seul (1985) lit. review	**3-24 %** **1.3 %** (Japan)
Grandel (1985) lit. review	**2-10 %**
McLean et al. (1979), Australia	**1.5 %** motorcycles **2.9 %** passenger cars
Treat (1977), USA	**4.5 %** passenger cars

Between 1.3 % and 24 % of the vehicles involved in the traffic accident had technical defects that caused the accidents.

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Word studies, research and publications

Percentage of vehicles with technical defects that contributory caused the traffic accident

Study	Share
Haworth et al. (1997) (motorcycle crashes), Australia	**12 %** in total **28 %** of accidents involving single vehicle **7 %** of accidents involving multiple vehicles
Haworth et al. (1997) (single vehicle crashes), Australia	**3 %**
Asander (1993) lit. Review	**23 %** (direct causes or increasing damage or injury) (Finland) **7-9 %** (significant impact, related impact, or increase in connections with traffic accidents) (Denmark)
Case et al. (1991)	**5.8 %**
Rompe & Seul (1985) lit. review	**4 – 19 %** (possibly up to 33%)
Grandel (1985), Germany	**6.5 %** traffic accidents involving passenger cars **5 %** traffic accidents involving two-wheeled vehicles
CCRAM (1978) Melbourne (Forest and Youngman)	**5.8 %** (**0.6 – 1.8 %** of these defects can be detected by a technical inspection)
Treat (1977), USA	**12.6 %** vehicles

Between 3 % and 19 % of the vehicles involved in the traffic accident had technical defects that played a contributory role in the accidents.

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Word studies, research and publications

Effect of periodic technical inspection on the reduction in traffic accident rates

Study	Percentage reduction in accident rates
Schulz & Franck (2021)	in fatal accident rate, and accident rate with no proportion figures given in Punjab (Pakistan)
European Commission (2019)	**5 %** (in accident rate of mopeds in Spain) **18 %** (in fatalities in Spain)
Schulz & Scheler (2019)	**40 %** (in accident rate in Costa Rica)
Hoagland et al. (2018)	**0 %** following the abolition of compulsory technical inspections in the state of New Jersey
Schulz & Scheler (2016)	**10 %** (in accident rate in Tukey)
Keall & Newstead (2013), New Zealand	**8 %** (during the transition from an annual to a semi-annual frequency of technical inspections)
Rune Elvik (2001), Norway	**5 – 10 %** (with an increase in the frequency of technical inspections by 100%)
Fosser (1992), Norway	**0 %** (Norway has significant random roadside inspection program)
Asander (1992), Sweden	**16 %** (in accident rate with serious injury)
NHTSA (1989), USA	**10 %** (in accident rate) **0 %** (in fatal accident rate)
White (1986), New Zealand	**10 – 15 %** (in accident rate)
Rompe & Seul (1985) lit. review	**50 %** (in accident rate)
Loeb & Gilad (1984), USA	in fatal accident rate, and accident rate with no proportion figures given
Berg et al. (1984), Sweden	**14 %** (in police reported accidents) **15 %** (in accident rate with serious injury)
Crain (1981), USA	reduction in accident rate, but no figures given
Schroer & Peyton (1979), USA	**9,1 %** (in accident rate, after technical inspection, compared to uninspected vehicles) **21 %** (in accident rate, after periodic technical inspection, compared to uninspected vehicles) **5.3 %** (in accident rate for inspected vehicles compared to accident rates of vehcles before the inspection)
Little (1971), USA	**5 %** (in death rates)

The effect of the technical inspections system on accident rate ranged from no effect to a 40 % reduction.

The main causes of traffic accidents in Slovak Republic

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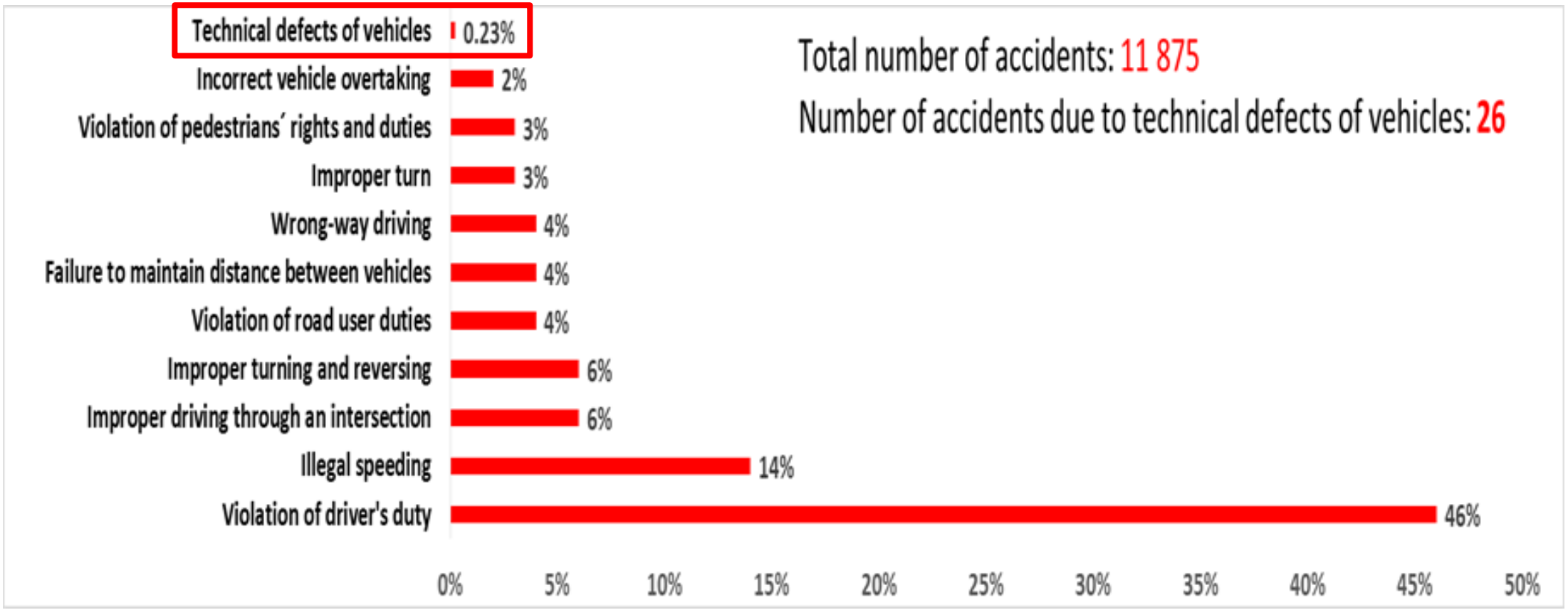
The most common major causes of traffic accidents in the Slovak Republic (in 2020)



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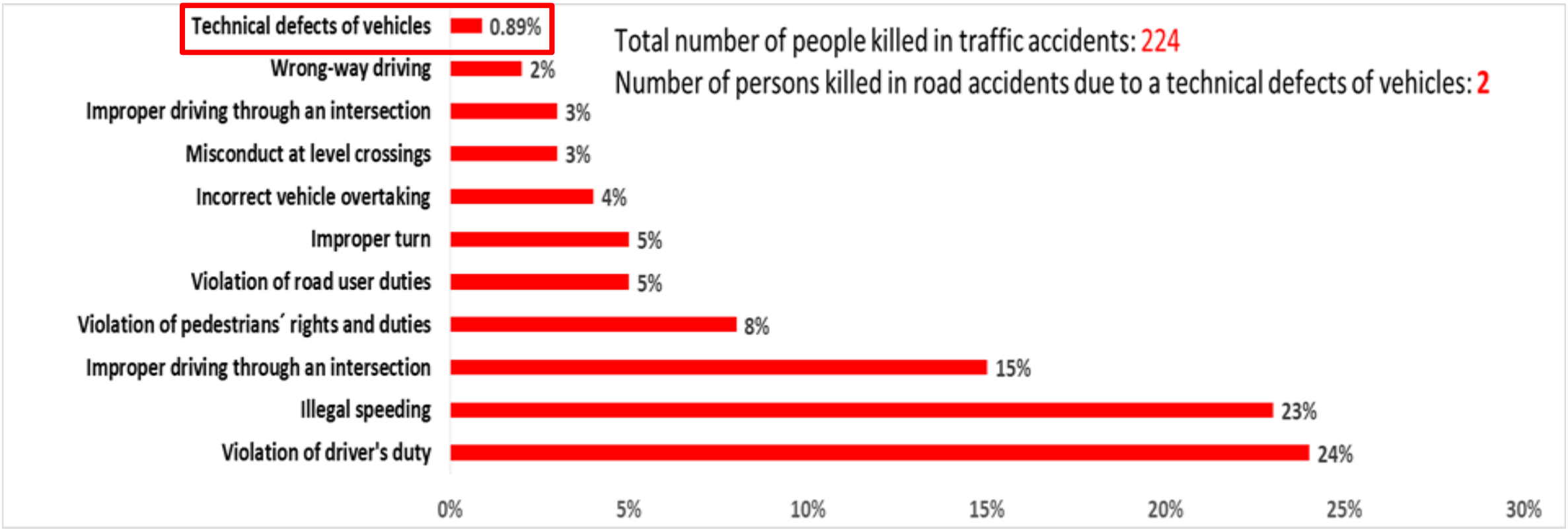
The main causes of traffic accidents in Slovak Republic

The most common major causes of traffic accidents in the Slovak Republic that resulted in the death of a person (in 2020)



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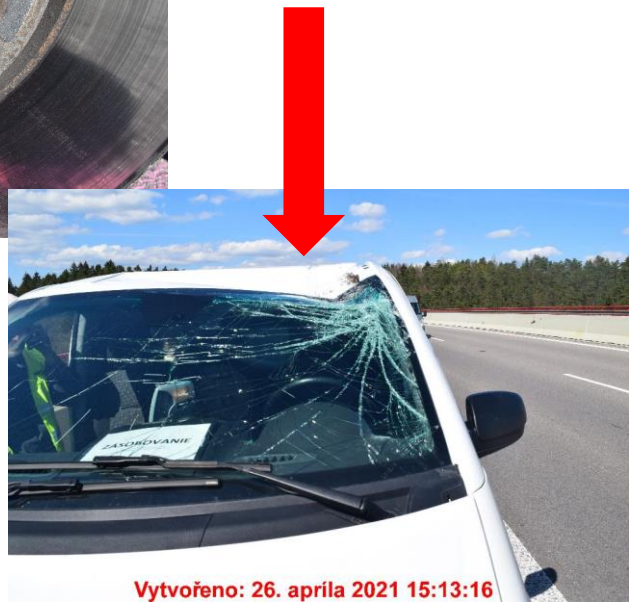
Technical defects of vehicles as the main cause of traffic accidents - statistics

Percentage of accidents caused by technical vehicle defects in selected countries and periods

Country (year)	proportion of accidents caused by technical defects of vehicles [%]
Slovak Republic (2020)	**0,23**
Czech Republic (2020)	0,4
Austria (2020)	1,1 (only with injuries)
Germany (2020)	1,2 (only with injuries)
Great Britain (2020)	3,84
USA (average of all states without the obligation of periodic TI) (2017)	0,83
USA (average of all states with the obligation of periodic TI) (2017)	0,61

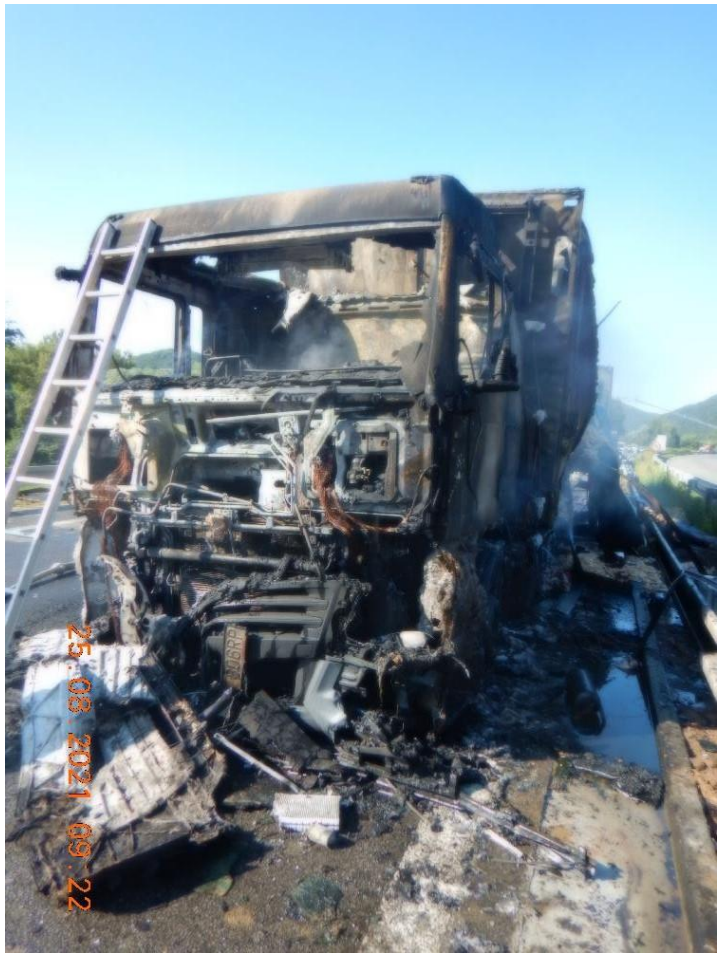
Traffic accident due to a technical vehicle defect in Slovakia – occurred suddenly and whithout the possibility of being influenced by a driver. It is judged by a court expert.

Traffic accident by technical defects of vehicle (sample photos from Slovakia)



Technical defect – „cutting“ two hub bolts.
Consequence: the wheel fell off and crashed into another vehicle.

Traffic accident by technical defects of vehicle (sample photos from Slovakia)



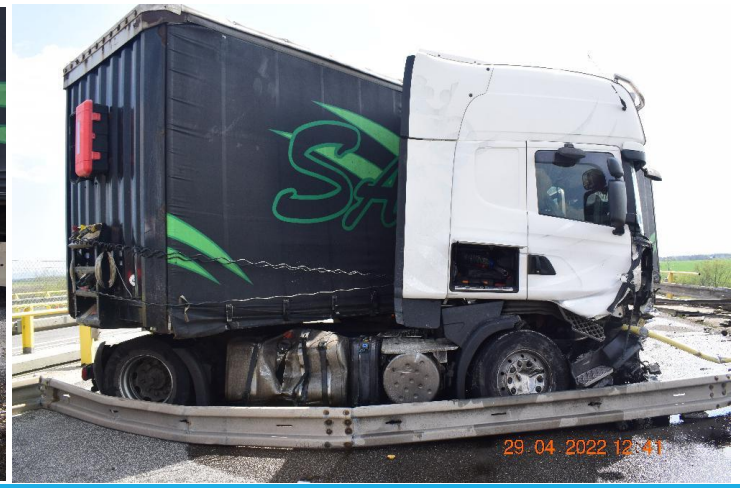
Technical defect – fuel system failure.
Consequence: the vehicle burned down.

Traffic accident by technical defects of vehicle (sample photos from Slovakia)

Technical defect – tire damage with sudden air leakage. Consequence: the vehicle was out of control and crashed into an oncoming vehicle.

Traffic accident by technical defects of vehicle (sample photos from Slovakia)

Technical defect – tire damage with sudden air leakage.
Consequence: the vehicle was out of control, crashed through the middle barriers on highway and stopped in the opposite direction.



Traffic accident by technical defects of vehicle (sample photos from Slovakia)

Technical defect – failure of the service brake.
Consequence: the vehicle was crashed to the bridge railing.

Traffic accident by technical defects of vehicle (sample photos from Slovakia)

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Technical defect – parking brake inoperative.
Consequence: the bus crashed downhill.
13 people dead and 25 were injured !!!

Analysis of statistical data of traffic accidents by technical defects of vehicles as the main cause of traffic accidents in Slovakia

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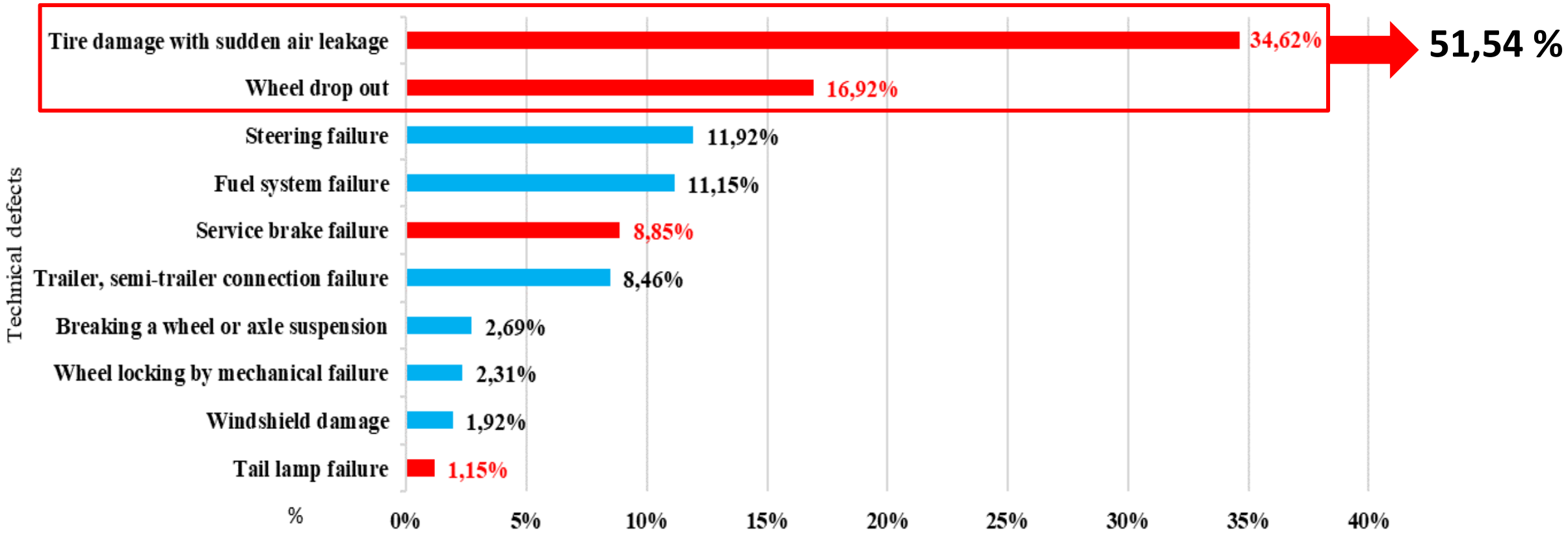
Technical defects of vehicles that directly caused traffic accidents in the Slovak Republic in the period 2016-2020



51,54 %

Analysis of statistical data of traffic accidents by technical defects of vehicles as the main cause of traffic accidents in Slovakia

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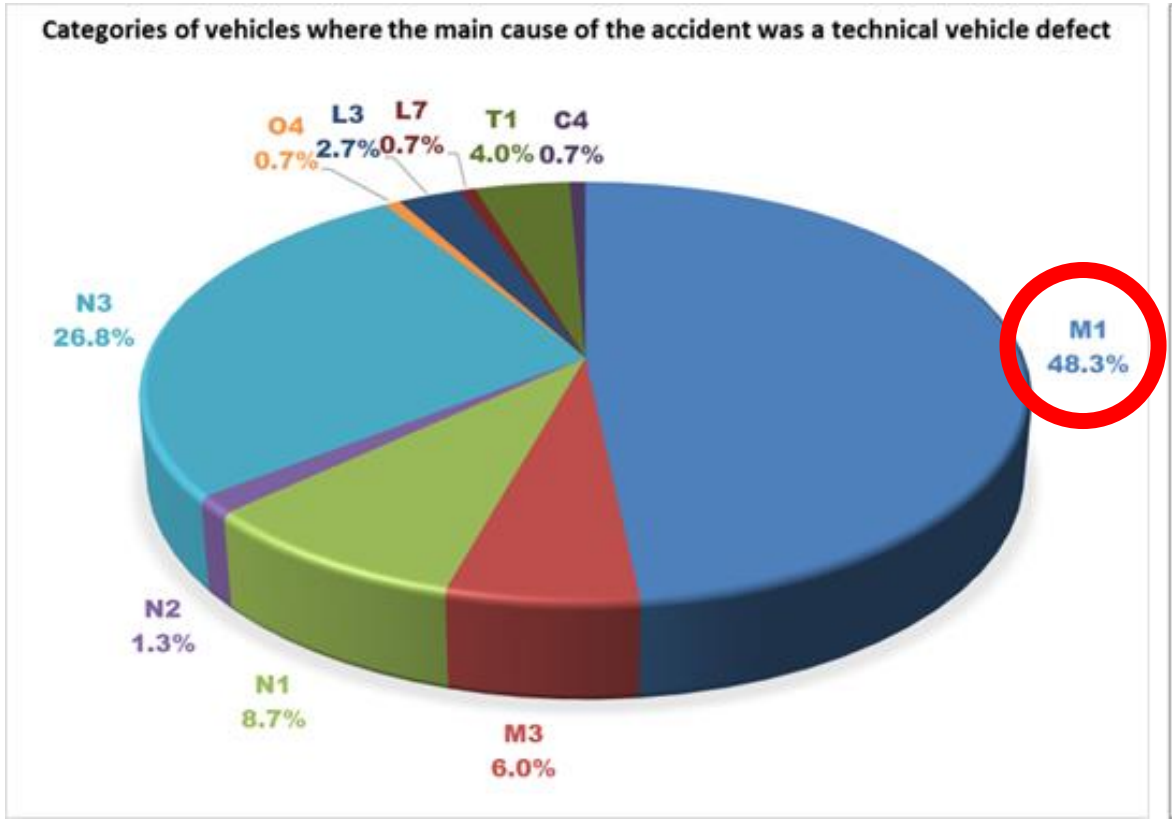
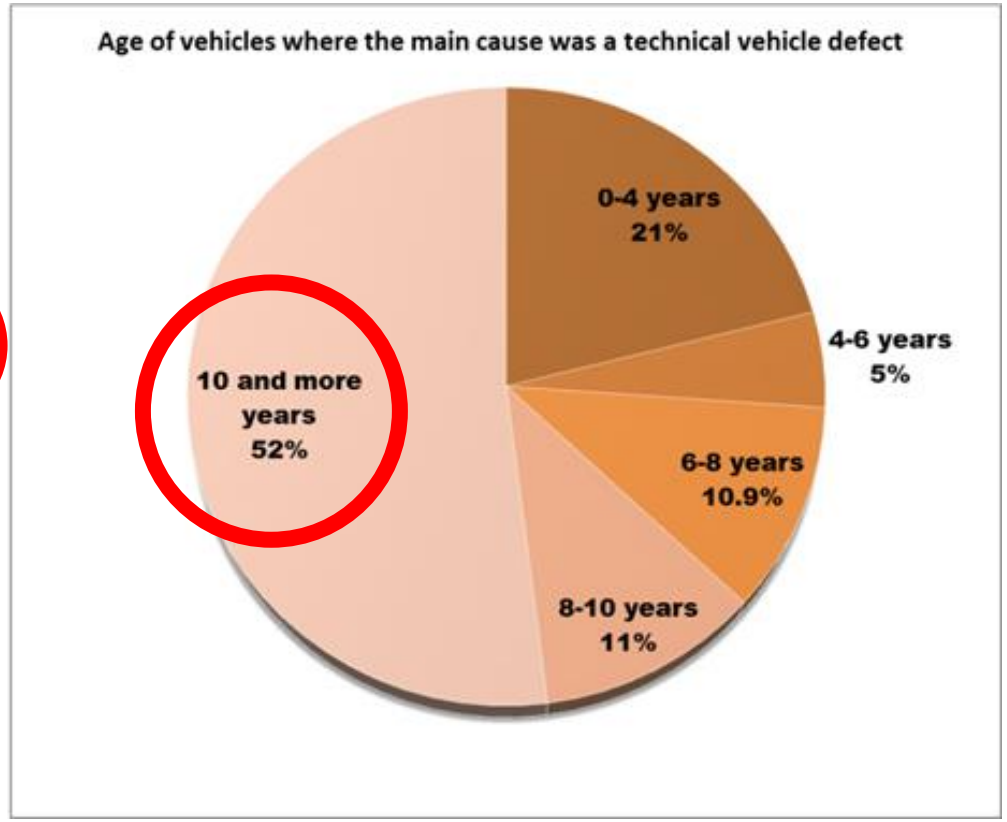
Percentage of categories of vehicles and age of vehicles, which caused traffic accidents by technical defects in the Slovak Republic in the period 2016-2020





Analysis of statistical data of traffic accidents by technical defects of vehicles as the main cause of traffic accidents in Slovakia

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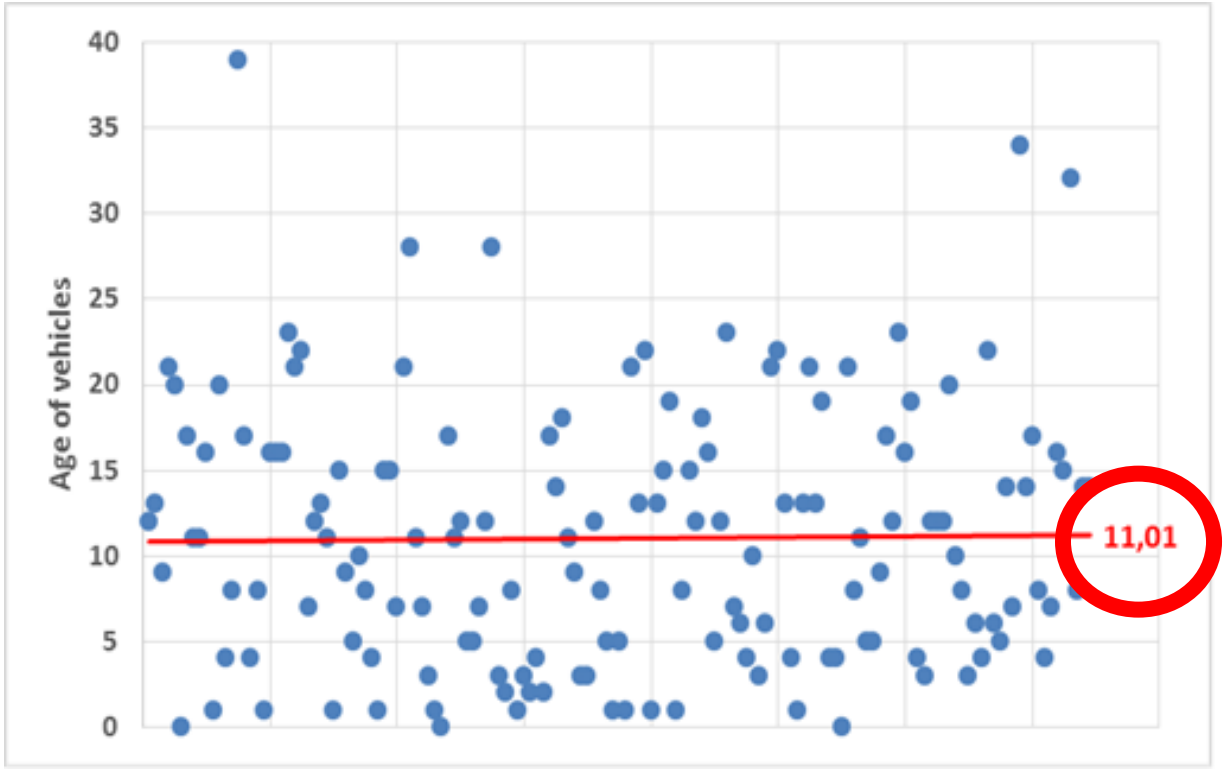
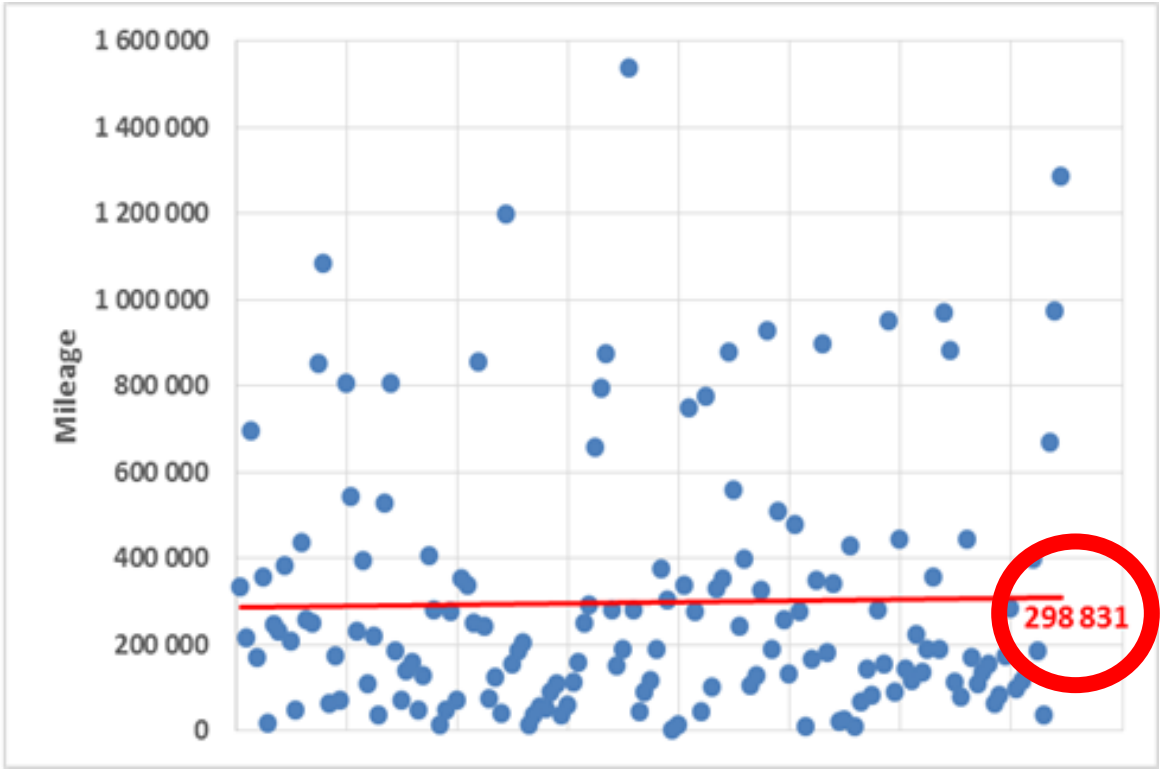
Distribution of age and odometer status of vehicles, which caused traffic accidents by technical defects in the Slovak Republic in the period 2016-2020





Analysis of statistical data of traffic accidents by technical defects of vehicles as the main cause of traffic accidents in Slovakia

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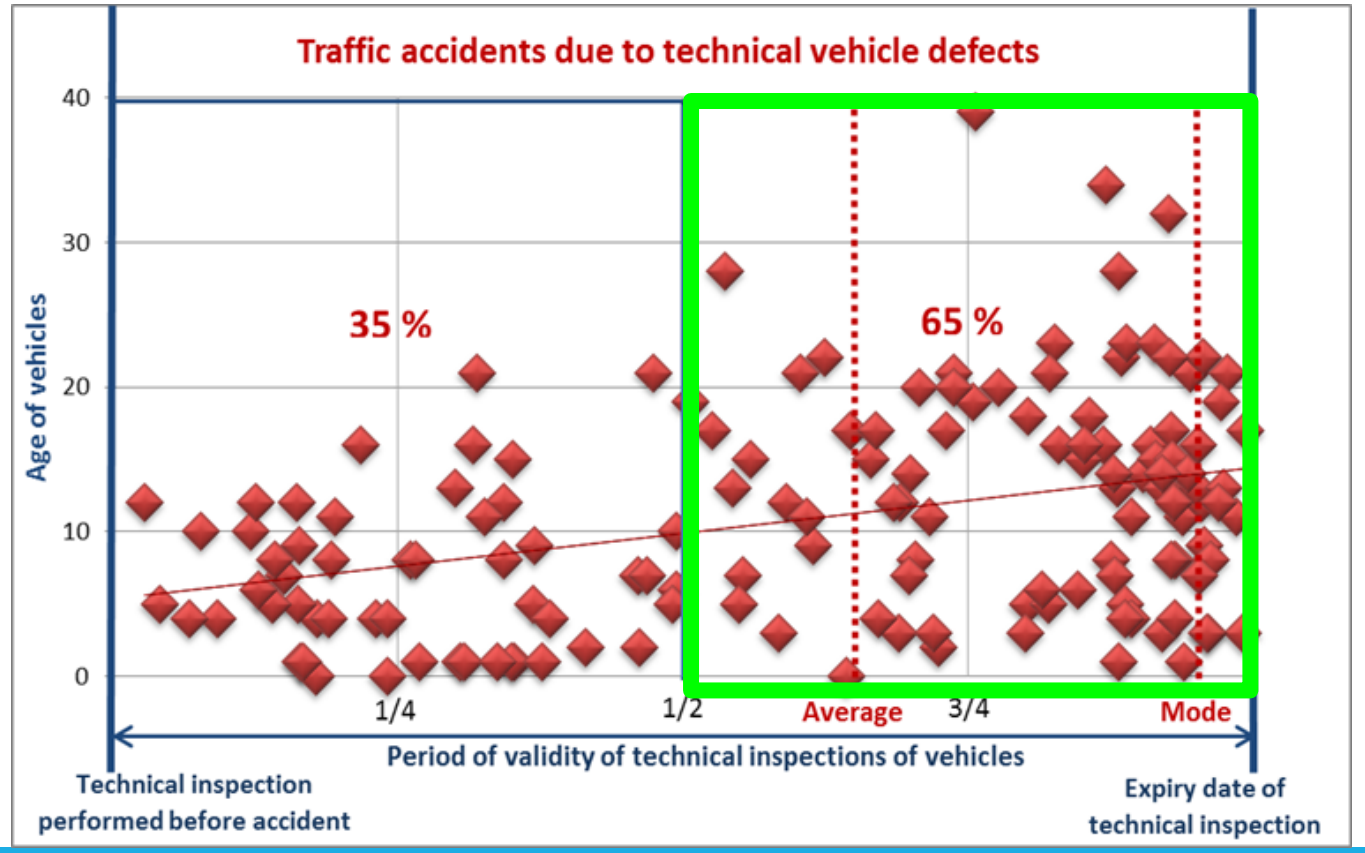
Temporal distribution of all accidents by technical defects of vehicles in the period from the performance of the technical inspection before the accident until the end of its validity in the Slovak Republic in the period 2016-2020



183 vehicles with 260 technical defects

Analysis of statistical data of traffic accidents by technical defects of vehicles as the main cause of traffic accidents in Slovakia

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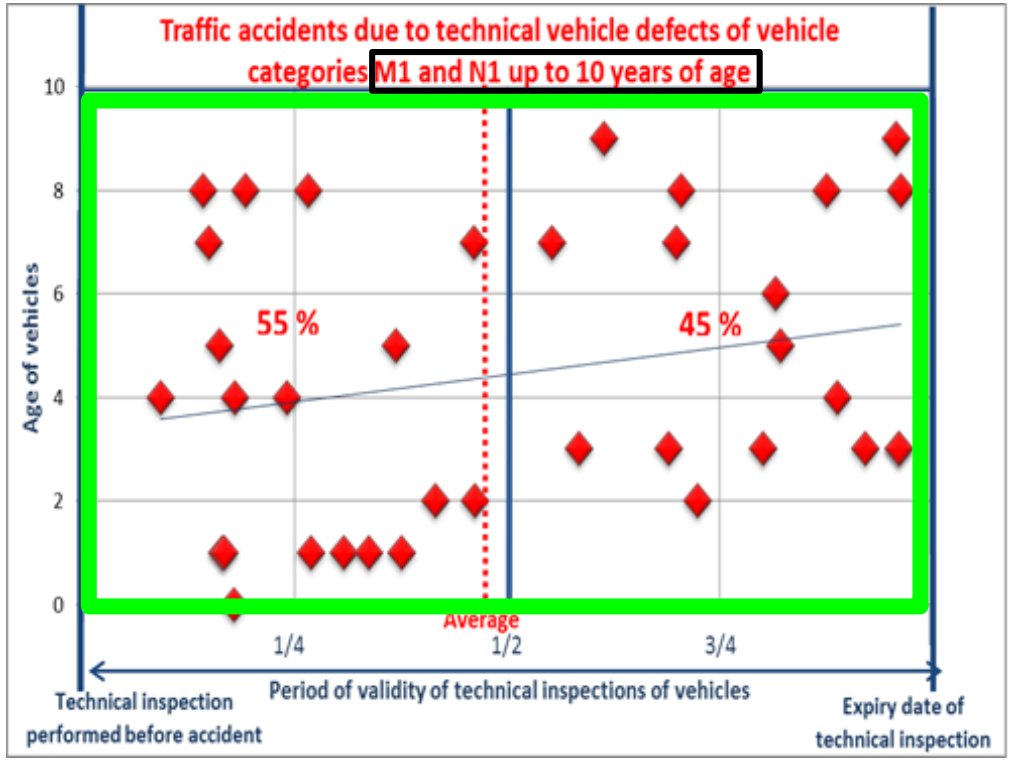
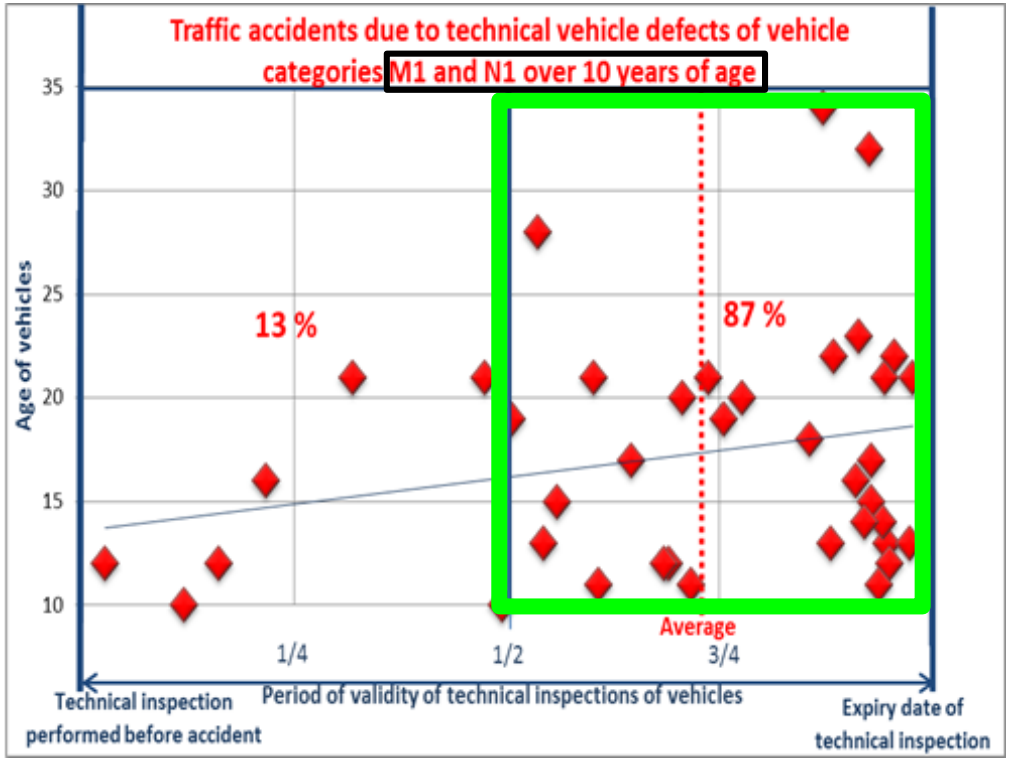
Temporal distribution of traffic accidents by technical defect of M1 and N1 category of vehicles aged up to 10 years and over 10 years in the period from the performance of technical inspection before the accident to the end of its validity in the Slovak Republic in the period 2016-2020





Periods of technical inspections in Slovakia

Vehicles of categories M1 and N1:

First time 4 years after the first registration and then at two-year intervals.

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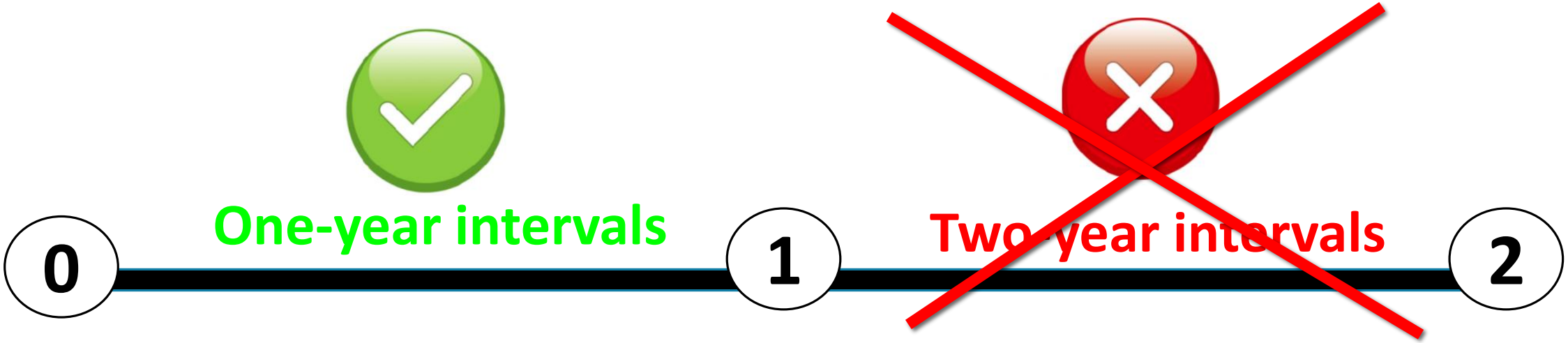
What is the result from this?

Shortening the period of PTI for M1 and N1 vehicles older than 10 years to one-year intervals could reduce the number of accidents for this vehicle category.



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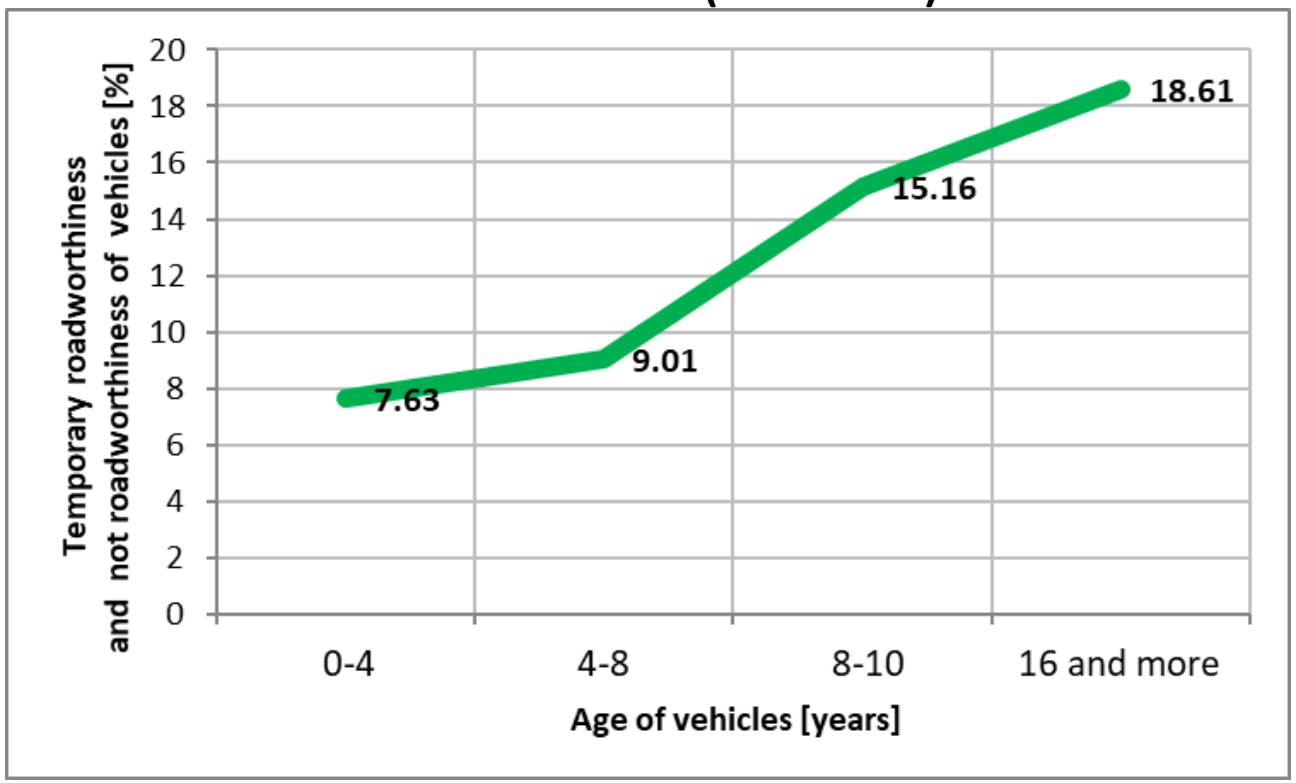
Effect of vehicle age on PTI results

Dependence of occurrence of vehicle defects on the age of the vehicle in the Slovak Republic in the period 2019-2021 (PTI results)

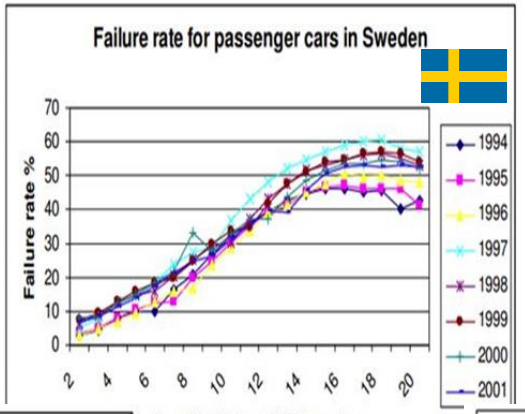


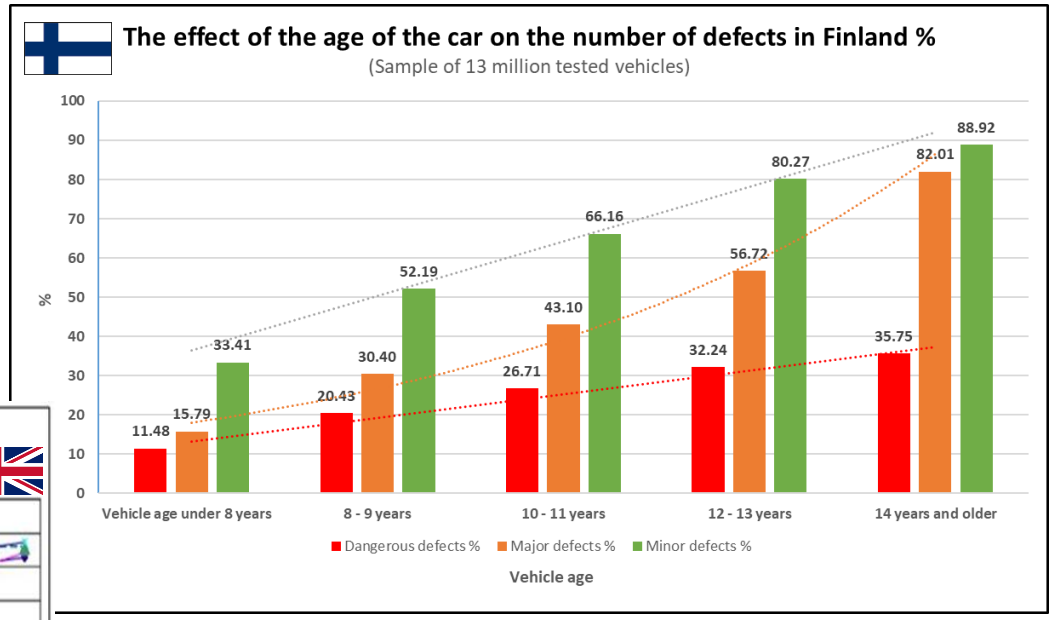
Sample of **3,554,432** tested vehicles

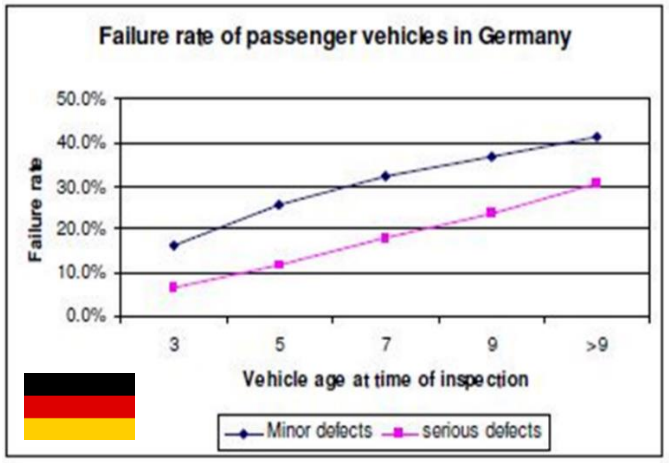
Source:
Juraj Hudec, Renáta Czödörová, Branislav Šarkan:
Examination of the results of the vehicles technical inspections in relation to the average age of vehicles in selected EU states
https://doi.org/10.1016/j.trpro.2021.07.063

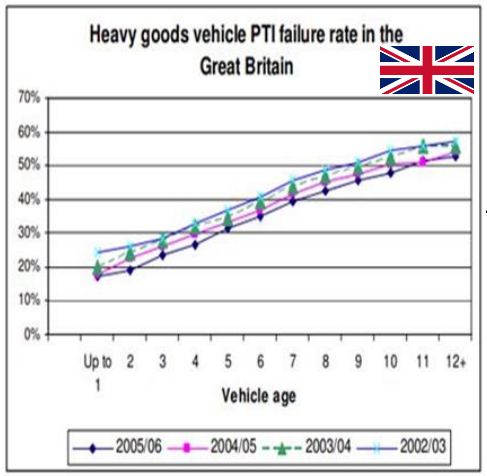
Effect of vehicle age on PTI results

Dependence of occurrence of vehicle defects on the age of the vehicle in the selected countries (PTI results)









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Calculation of correlation of the results of technical inspections of vehicles with traffic accidents by technical defects of vehicles in Slovakia

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Assessment of the technical condition of vehicles by PTI as temporarily roadworthy and not roadworthy and the number of traffic accidents caused by technical vehicle defects in each year in the period 2012 – 2020

Year		2012	2013	2014	2015	2016	2017	2018	2019	2020
Temporarily roadworthy and not roadworthy vehicles	Quantity	30 757	40 835	58 130	98 689	97 114	70 627	84 711	162 836	165 629
Accidents due to technical defects	Quantity	48	49	46	39	37	47	37	35	26

$$r(X,Y) = \frac{S_{XY}}{S_X S_Y} = \frac{\sum_{i=1}^{n}(X_i-\bar{X})(Y_i-\bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i-\bar{X})^2}\sqrt{\sum_{i=1}^{n}\left((Y_i-\bar{Y})\right)^2}} = -0.91$$

P-value = 0.000641 < α(0.05)

r ϵ<-1;1>

- if $0 \leq |r| < 0.3$, between *X* a *Y* is negligible dependence
- if $0.3 \leq |r| < 0.5$, between *X* a *Y* is low dependence
- if $0.5 \leq |r| < 0.7$, between *X* a *Y* is moderate dependence
- if $0.7 \leq |r| < 0.9$, between *X* a *Y* is high dependence
- **if $|r| \geq 0.9$, between *X* a *Y* is very strong dependence**

With the increasing number of vehicles assessed at the PTI as temporarily roadworthy and not roadworthy, the number of traffic accidents by technical defects of vehicle was decreasing.

Regression analysis of the results of technical inspections of vehicles and number of traffic accidents by technical defects of vehicles

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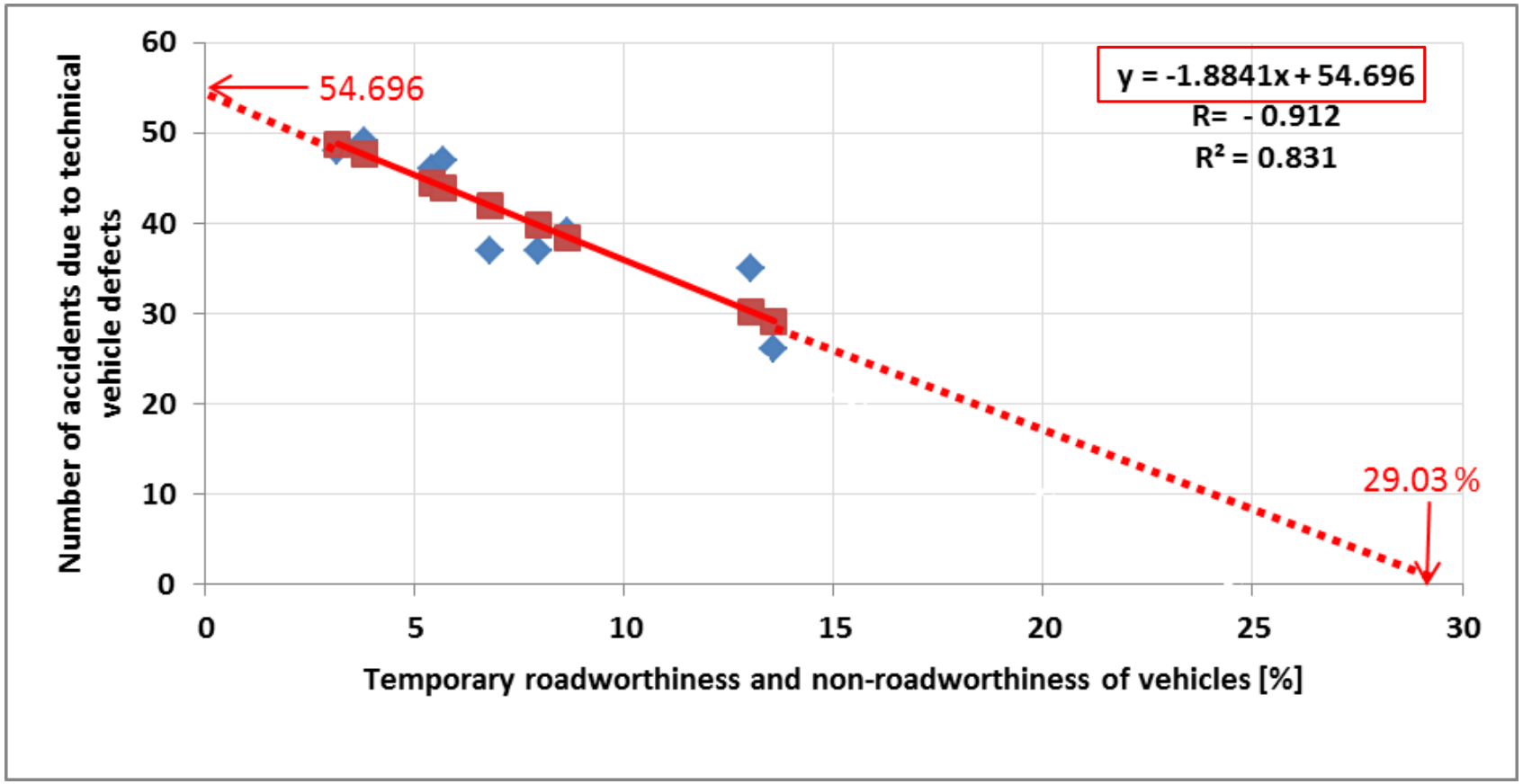
Regression line and function



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Results and conclusions

Finding No. 1

The least of traffic accidents by technical defects occurred after the performed technical inspection and the most before the end of validity of technical inspections, especially in categories M1 and N1 older than 10 years (87 %).

Finding No. 2

Calculated high degree of correlation between the results of technical inspections and the number of traffic accidents by technical defects (with the increasing number of temporary roadworthy and not roadworthy of vehicles, the number of traffic accidents by technical defects was decreasing).

PTI affecting traffic accidents by technical defects.

Measure No. 1

Shortening the period of PTI for M1 and N1 vehicles older than 10 years to one-year intervals could reduce the number of accidents for this vehicle category.

Measure No. 2

Application of measures to increase the quality of PTI operation, so that the rate of vehicle evaluation at PTI reflects the reality (e.g. an efficient supervision over the PTI, application of ISO standards, etc.)

PTI have a positive impact on road safety and therefore justification.
Improving the quality of operation of the PTI stations increases the road safety.

The End

Thank you for your attention.

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