

# IMPACT OF SIGNIFICANT FACTORS ON ASSESSING THE TECHNICAL CONDITIONS OF VEHICLES AT TECHNICAL INSPECTION STATIONS

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## Abstract

The paper analyses the assessment of the technical condition of vehicles at technical inspection stations in the Slovak Republic in the period of 2007-2019. There are described the legislative conditions for assessment of the technical condition of vehicles at technical inspections stations in the Slovak Republic. Data from technical inspections and defects within all technical inspection stations was recorded in the nationwide information system. These data was used as base for the next analysis. This paper also describes the possibilities for detection of deficiencies at technical inspection stations, and in the final part the impact of expert supervision on the operation of the selected technical inspection stations was analysed. The paper also examines significant factors affecting the assessment of the technical condition of vehicles at technical inspection stations in the Slovak Republic. The first factor represents legislative measures introducing more sophisticated technical means to control technical inspection stations, and the second factor is technical supervision by supervisory authorities over technical inspection stations.

**Keywords:** road transport; road safety; technical inspection; technical inspection station; unroadworthy vehicle

## 1. Introduction

Traffic accidents represent a serious society-wide problem with a huge impact on people's lives and property [19]. This requires a high level of attention. One of the factors affecting traffic accidents is the technical condition of vehicles. The network of technical inspection stations (TISs) has been created because is necessary to protect the citizens and their

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property. The competence to supervise the technical condition of vehicles and their parts has been transferred to the private sector while the state carries out professional supervision of this activity. The primary objective of the state is to ensure that the technical conditions of vehicles are assessed as objectively as possible, and thus only roadworthy vehicles are operated on roads [2, 15]. Therefore, the results of the assessment of the technical condition of vehicles, namely unroadworthiness of vehicles for road operation, is a parameter that is monitored very closely. Too low proportion of such assessment of the total number of inspected vehicles is considered as an undesirable phenomenon and it is even one of the reasons for choosing a technical inspection station for control.

## 2. Assessment of the Technical Condition of Vehicles at Technical Inspection Stations

A technical inspection is the inspection and assessment of the technical condition of the vehicle, its systems, components or separate technical units. Each inspected area within a technical inspection contains one or more inspection operations (actions). Each inspected area includes the list of possible defects and levels of their severity [1, 22, 17].

The development of the number of registered vehicles subjected to technical inspection and the number of technical inspection stations in the period 2007-2019 in the Slovak Republic shows The Figure 1. The number of vehicles subjected to technical inspection increases from year to year but in 2018 it was possible to observe a slump; this is because, with the entry into force of the new road traffic legislation. In Slovak Republic were in 2007 registered 1 987 611 vehicles subjected to technical inspection. At the end of 2019 there were already 3 051 648 vehicles (increase by 893 902 vehicles compared to 2007). Data in the Figure 1 indicates that in 2007 the technical inspection authorization was issued for 87 technical inspection stations and at the end of 2019 technical inspections were carried out by 151 technical inspection stations. In 13 years, the number of technical inspection stations has increased by 64, this represents an increase of 42% compared to the original situation.

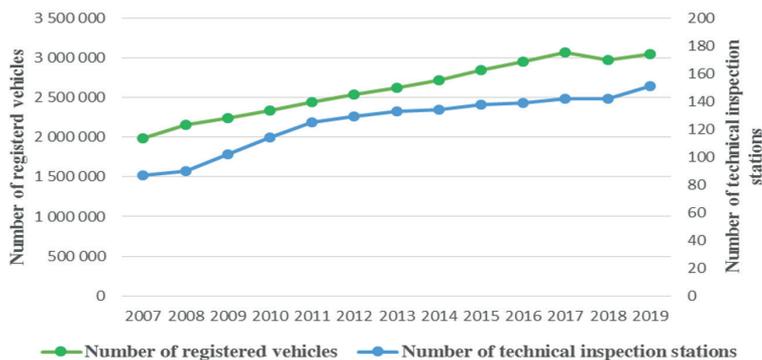


Fig. 1. The development of the number of registered vehicles subjected to technical inspection and the number of technical inspection stations in the period 2007-2019 in the Slovak Republic

During the technical inspection, the vehicle technical condition and the function of its individual systems, components and separate technical units are assessed by defects which belong to the following groups:

- a) minor defects that do not have a significant impact on vehicle safety or the environment as well as other less significant cases of nonconformity; the vehicle is "roadworthy for road operation",
- b) serious (major) defects which may affect vehicle safety or the environment, or may endanger other road users as well as other more significant cases of nonconformity; the vehicle is "temporarily roadworthy for road operation"
- c) dangerous defects which represent direct and imminent risk to road safety or have the impact on the environment and it is necessary to prohibit the use of the vehicle in road traffic; the vehicle is "unroadworthy for road operation" [8].

The defects classification into individual groups is described in Decree No. 135/2018 Coll. laying down the details of roadside technical inspection [7].

In case of detecting vehicles with defects belonging to more than one group, the assessment is made based on the error corresponding to the most serious error. The vehicle showing several defects within the same inspection area as defined by the inspection scope can be assigned to the nearest group of more serious defects if it can be demonstrated that the combined effect of these defects results in a higher degree of road safety threat [6, 8, 11].

The technical condition of vehicles is not evaluated during the technical inspection if it is not possible to carry out all the prescribed inspection actions due to failure of any of the prescribed technical equipment of the technical inspection station and this situation is not caused by a vehicle fault or by the driver's actions [7, 13, 18].

A vehicle is considered as "roadworthy for road operation" if the technical inspection is carried out to the specified scope and the vehicle shows no defects or minor defects. A vehicle is considered as "temporarily roadworthy for road operation" if the technical inspection is carried out to the specified scope and the vehicle shows at least one serious error and no dangerous error is detected. A vehicle is considered as "unroadworthy for road operation" if:

- a) the technical inspection is carried out to the specified scope,
- b) at least one dangerous error is detected, or
- c) the same serious error is repeatedly detected during the technical inspection [8].

Data on defects detected during technical inspections in terms of the individual inspected items and conclusions on roadworthiness, temporary roadworthiness and unroadworthiness of the vehicle for operation on roads are recorded in the nationwide information system. Data on technical inspections and defects within all technical inspection stations was also recorded in the nationwide information system [9, 10, 12].

### 3. The Results of Assessing the Technical Condition of Vehicles at Technical Inspection Stations in the Slovak Republic in 2007-2019 and Their Analysis

The assessment results of the technical condition of vehicles at technical inspection stations in the period of 2007-2019 are provided in Table 1 [16].

**Tab. 1. Assessment of the technical condition of vehicles for individual years**

Vehicle assessment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
unroadworthy + temporarily roadworthy [%]	5.54	5.14	4.52	4.03	3.69	3.15	3.8	5.42	8.63	7.96	5.69	6.54	12.09
roadworthy [%]	94.46	94.86	95.48	95.97	96.31	96.85	96.20	94.58	91.37	92.04	94.31	93.46	87.91

Based on the results of the technical condition of vehicles assessed by technical inspection stations, it is clear that the number of vehicles assessed as unroadworthy or temporarily roadworthy was gradually decreasing in the period 2007–2012. The historical minimum can be observed in 2012. Subsequently in 2013, the number of unroadworthy or temporarily roadworthy vehicles began to rise till 2015. Then, the decrease can be observed till 2017 and this number started to rise from 2018 [16, 5].

The first breakthrough year was 2013 when the first increase in the number of unroadworthy or temporarily roadworthy vehicles incurred. The second year of further progress was in 2018 and historical maximum of these values can be observed at the end of 2019 (almost double increase compared to 2018). Therefore, the significant factors affecting the assessment of the technical condition of vehicles by technical inspection stations are examined for 2013, 2018, and 2019. For this reason, it is necessary to analyse in more detail the course of assessing the technical condition of vehicles in mentioned years and to define the factors which represented the causes [16, 25, 4]. The Table 2 analyses the assessment of the technical condition of vehicles during 2013.

**Tab. 2. Assessment of the technical condition of vehicles during 2013**

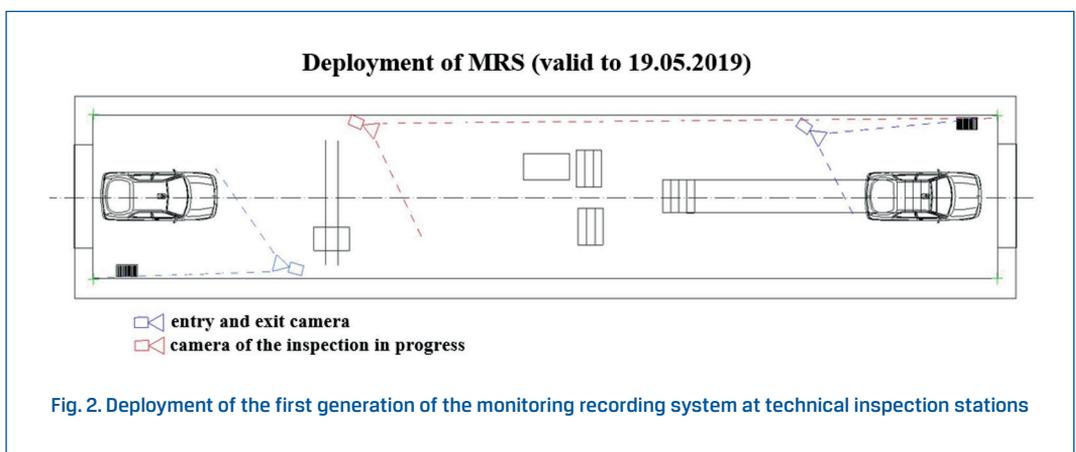
Months in 2013	Unroadworthy and temporarily roadworthy vehicles at TISs [%]
January	2.73
February	2.76
March	2.82
April	2.85
May	2.93
June	3.85
July	4.15

**Tab. 2. Assessment of the technical condition of vehicles during 2013, cont.**

Months in 2013	Unroadworthy and temporarily roadworthy vehicles at TISs [%]
August	4.35
September	4.56
October	4.68
November	4.74
December	5.23

Based on the data from 2013, it can be concluded that a breakthrough month, from which the values started to rise, was June. This was caused by the introduction of the first generation of the camera system at technical inspection stations in that time (specifically as of 30 June 2013) and subsequent monitoring of the work of the technicians of technical inspection stations by evaluating the video records by supervisory authorities. Technicians' knowledge about the use of camera system by which supervisory authorities can supervise them as well as the penalties imposed for incorrect assessment of vehicles caused technicians to carry out technical inspections more consistently after the introduction of these measures [16, 23].

According to the legislation in force at the time, each technical inspection station had to be equipped with an approved monitoring recording system (MRS) consisting of an entry, exit camera and a camera recording the inspection in progress as is it shown in the Figure 3. The entry and exit camera recorded photographs of vehicles at the entry and exit of the inspection process and another camera made a continuous video recording from the inspection in progress according to the deployment of cameras as shown in Figure 2 (valid from 30.06.2013 to 19.05.2019).



From 2013, the number of unroadworthy or temporarily roadworthy vehicles annually increased till 2015. The subsequent decline in the number of those vehicles at technical inspection stations can be observed till 2017. This could be caused by a certain habit of using

MRS as well as the fact that the archiving period of the video records was only one month according to the legislation in force at the time, and therefore not all infringements and not all technical inspection stations could be checked. This might give technicians the feeling that they would not have to be sanctioned and they slacked off [20]. The Table 3 analyses the assessment of the technical condition of vehicles during 2018.

**Tab. 3. Assessment of the technical condition of vehicles during 2018**

Months in 2018	Unroadworthy and temporarily roadworthy vehicles at TISs [%]
January	5.43
February	5.50
March	5.41
April	5.93
May	6.15
June	6.18
July	6.83
August	7.10
September	7.22
October	7.56
November	7.57
December	7.54

The new Act No. 106/2018 Coll. on the operation of vehicles in road traffic [1] as amended, the implementing decrees to this act and methodological instruction of the Ministry of Transport and Construction of the SR came into force on 20 May 2018. Among other things, this act introduced the second generation of the improved MRS (technical inspection stations were obligated to be equipped with this MRS by 20.05.2019). The act also introduced a new information system for technical inspection stations as well as other additional supervisory authorities and the possibility of imposing stricter sanctions was adopted. These measures resulted in a progress in the assessment of temporarily roadworthy and unroadworthy vehicles (approximately since these legislative changes came into force) [1, 3, 24]. Table 4 analyses the assessment of the technical condition of vehicles during 2019.

**Tab. 4. Assessment of the technical condition of vehicles during 2019**

Months in 2019	Unroadworthy and temporarily roadworthy vehicles at TISs [%]
January	7.93
February	9.06
March	9.21
April	9.71
May	13.01
June	14.45

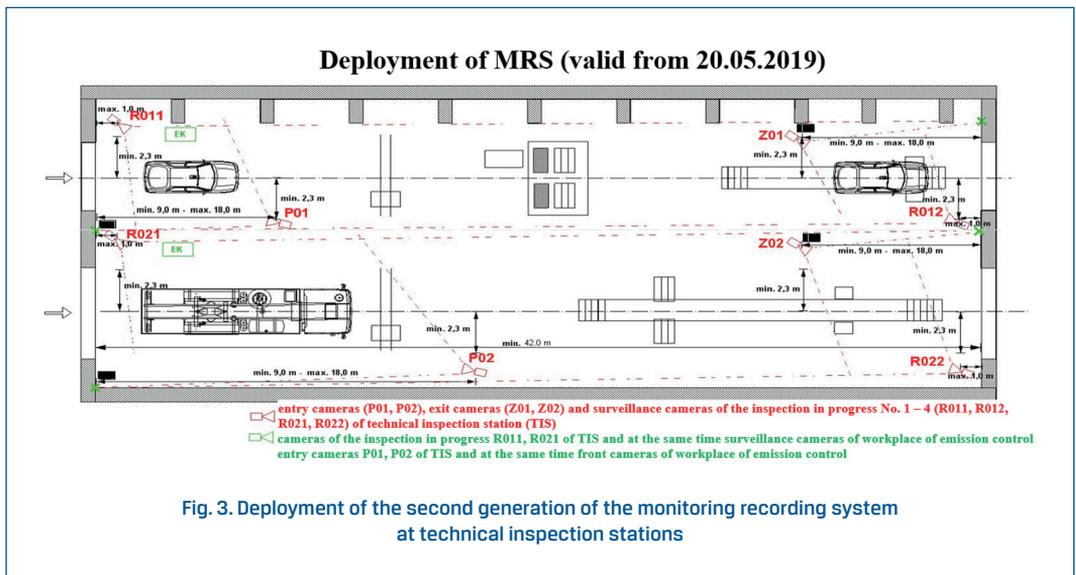
Tab. 4. Assessment of the technical condition of vehicles during 2019, cont.

Months in 2019	Unroadworthy and temporarily roadworthy vehicles at TISs [%]
July	14.36
August	13.84
September	13.34
October	13.46
November	13.28
December	13.46

The data from 2019 showed that a breakthrough month, in which the values started to rise sharply as it shows Figure 5, was May. The reason was the end of the transitional period of equipping technical inspection stations with the second generation of MRS (no later than 20.05.2019) and subsequent controlling the work of the technicians of technical inspection stations by evaluating the video records from MRS by supervisory authorities.

The second generation of the monitoring recording system is shown in the Figure 3 and it shall meet the following technical requirements:

- entry and exit camera with automatic recognition of vehicle registration number,
- two surveillance cameras covering the entire length of the inspection line,
- specific conditions for the location and storage of video records (video and photo frequency, video archiving time increased to two years),
- mounting of cameras without possibility of changing their direction [1, 8].



Technicians' knowledge about the use of camera system by which supervisory authorities can supervise as well as their actual checks and the penalties imposed for incorrect assessment of vehicles caused that technicians have started to carry out technical inspections more consistently.

## 4. Possibilities for Detection of Deficiencies at Technical Inspection Stations

The introduction of any technical measures and tightening of sanctions is ineffective if technical inspection stations are not controlled and sanctioned by these measures. For this reason, it was necessary to introduce an effective system of technical supervision over technical inspection stations, which is discussed in the following part of the paper.

Professional supervision of technical inspection stations is performed by authorized bodies/persons:

- Ministry of Transport and Construction of the SR (covering the whole territory of the SR)
- District Office (covering the territory of a particular district/region)
- Technical services (covering the whole territory of the SR).

The professional supervision is carried out based on the number of controls approved in the control and surveillance plan or based on the initiative. The control activity over technical inspection stations is directed by the Ministry of Transport and Construction of the SR [1, 8].

The supervision is carried out by authorized employees on the basis of an inspector's license. The license is issued by the Ministry of Transport and Construction of the SR to an authorized employee after meeting the following criteria:

- a driving license issued for at least category B,
- attendance of the basic training (new employees) or training courses for technicians (employees with a license issued under the previous legislation) [1, 6, 7].

When deciding on which technical inspection station is to be inspected, the supervisory authority shall examine in particular the following criteria:

- percentage of temporarily roadworthy and unroadworthy vehicles per one technician and workplace over a certain period,
- the number of inspections per technician over a certain period,
- the number of inspections per workplace over a certain period,
- the average time of inspection per technician and workplace,
- percentage of non-evaluated vehicles over a certain period,
- increase and decrease of the monitored criteria over time,
- previous misconduct and sanctions,
- complaints and operative information received from citizens [1, 8, 9].

The mentioned criteria are examined in particular from information systems for technical inspections and from statistical data. Within the preparation for supervision, the inspectors examine, for example, whether the rate of roadworthy vehicles is not too high, whether the number of inspections per technician exceeds his/her capabilities, whether the average time of technical and emission inspection per technician is not too short and etc. [6, 14, 21].

In particular, the following means are used for carrying out the inspection at technical inspection stations:

- a) A video analysis within which the inspectors evaluate the video records obtained from the approved monitoring recording system. The inspectors control in particular the activity of technicians and their compliance with the regulations.
- b) Analysis of data from a roller brake tester based on which it is examined whether the braking forces measured during the measurement correspond to the resultant values and whether the technician enters the originally measured data into the protocol. Further, it is assessed whether the technician measures the braking forces on all axles or if he/she repeatedly brakes only one axle and such measured force values then enter into the system as force for all axles, and etc.
- c) Repeated technical inspection of the vehicle that was inspected immediately before this inspection and then the differences between inspection results are evaluated.
- d) "mystery shopping" within which the vehicle with deficiencies is delivered for the technical inspection and the work of the technician is evaluated.
- e) the use of a mobile technical inspection station for a repeated technical inspection on vehicles that have just finished their inspection at a stationary technical inspection station.

## **5. The impact of Expert Supervision on the Operation of the Selected Technical Inspection Stations**

The following graphs in the Figures 4-11 show the impact of expert supervision on assessing vehicles by technical inspection stations. The red curve represents the assessment of vehicles at a specific technical inspection station for a certain period of 2019. This represents the vehicles evaluated as unroadworthy and temporarily roadworthy. The expert supervision was carried out over this technical inspection station and the deficiencies in its activity were detected and thus sanctions were imposed. The green curve shows the same type of assessment of vehicles for the previous year 2018 [16].

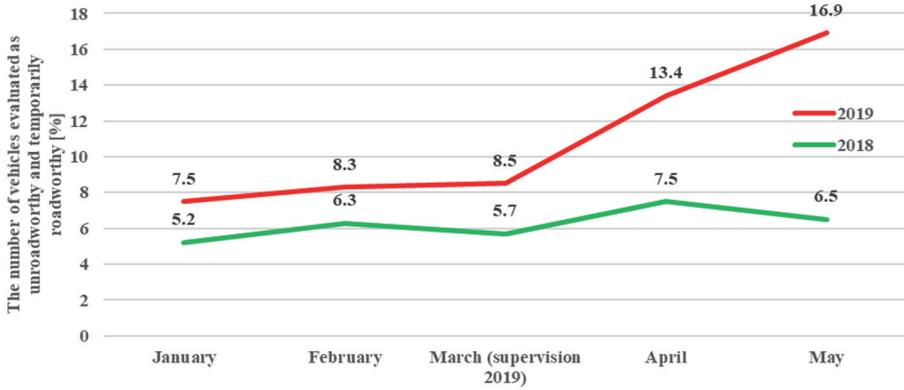


Fig. 4. Technical inspection station No. 1, expert supervision carried out in March 2019

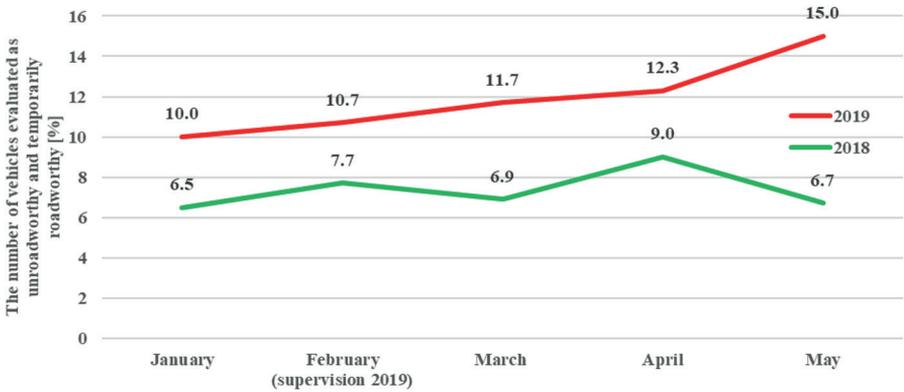


Fig. 5. Technical inspection station No. 2, expert supervision carried out in February 2019

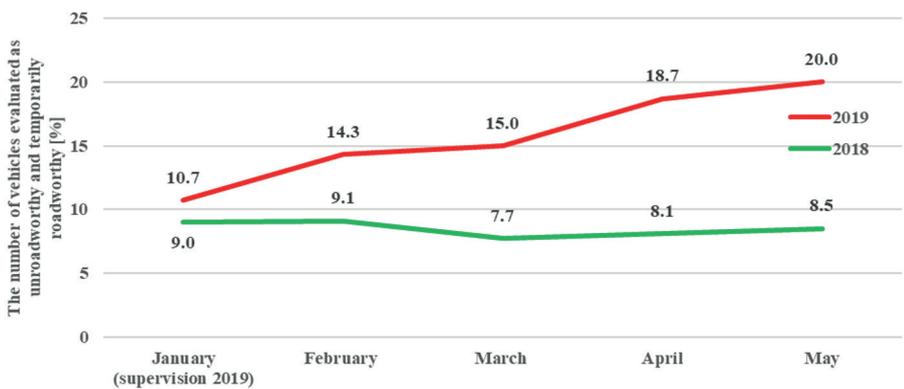


Fig. 6. Technical inspection station No. 3, expert supervision carried out in January 2019

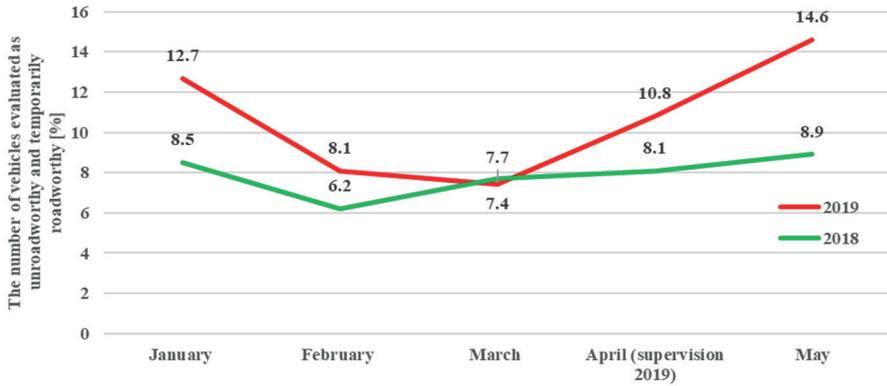


Fig. 7. Technical inspection station No. 4, expert supervision carried out in April 2019

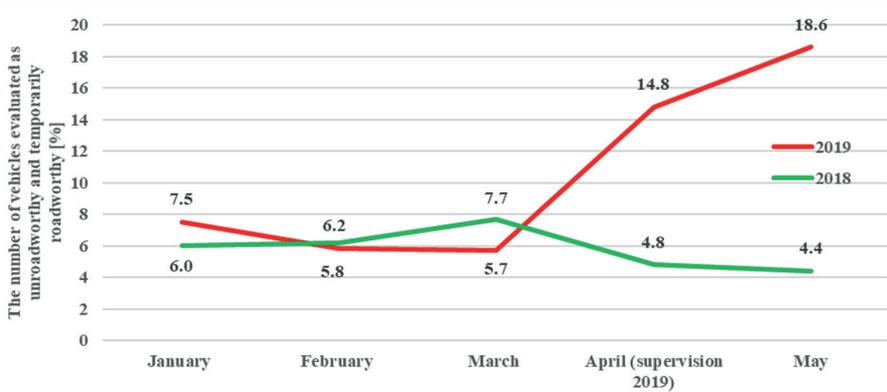


Fig. 8. Technical inspection station No. 5, expert supervision carried out in April 2019

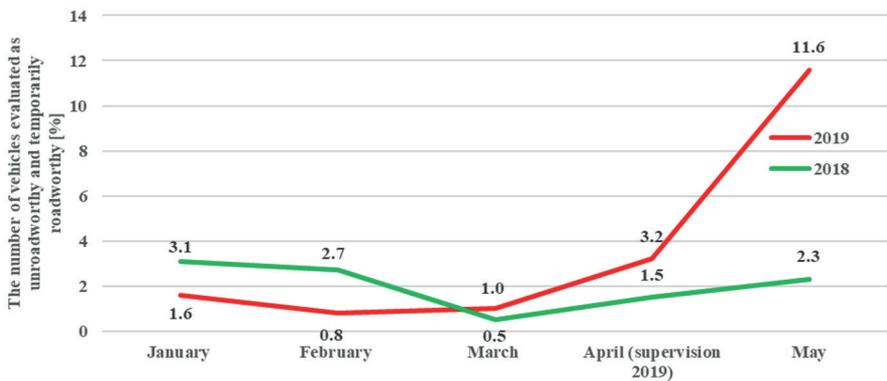


Fig. 9. Technical inspection station No. 6, expert supervision carried out in April 2019

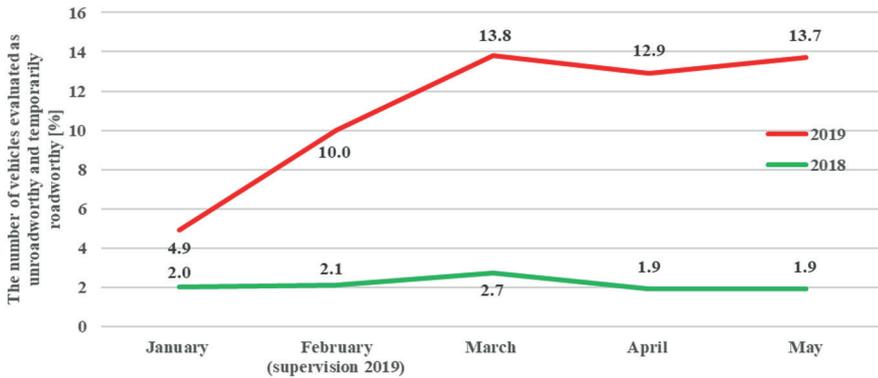


Fig. 10. Technical inspection station No. 7, expert supervision carried out in February 2019

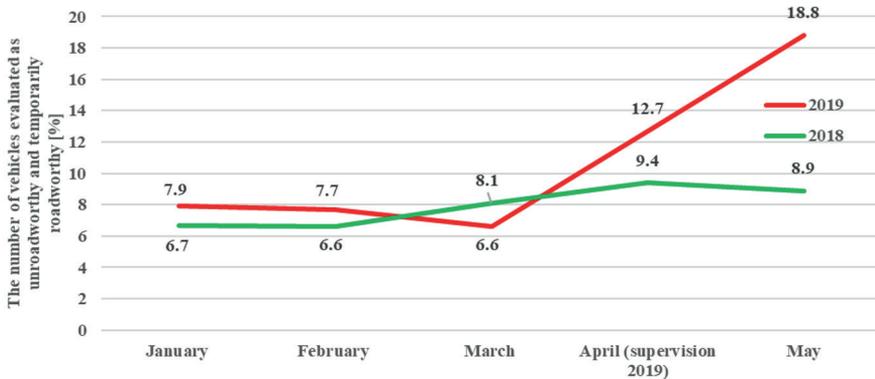


Fig. 11. Technical inspection station No. 8, expert supervision carried out in April 2019

The graphs showed that the expert supervision over technical inspection stations has a significant impact on assessing the technical condition of vehicles.

## 6. Conclusion

We made the analysis of vehicles assessed by technical inspection stations with results as unroadworthy and temporarily roadworthy. The number of vehicles assessed as unroadworthy or temporarily roadworthy was gradually decreasing in the period 2007-2012. The minimum was observed in 2012. Subsequently in 2013, the number of unroadworthy or temporarily roadworthy vehicles began to rise till 2015. Then, the decrease can be observed till 2017 and this number started to rise from 2018. For this reason, it was necessary to analyse in more detail the course of assessing the technical condition of vehicles in mentioned years and to define the factors which represented the causes.

The examination of the assessment of the technical condition of vehicles at technical inspection stations in the SR in 2007-2019 showed that the assessment of vehicles as unroadworthy and temporarily roadworthy depended on two significant factors. The first factor represented legislative measures introducing more sophisticated technical means to control technical inspection stations and the second factor was technical supervision by supervisory authorities over technical inspection stations.

Within examined period of 2007-2019, the number of vehicles assessed as unroadworthy and temporarily roadworthy started to increase from 2013 after introducing the first generation of camera systems and subsequently the rising trend continued from 2018 after introducing the second generation of camera systems. By the end of 2019, the number of vehicles assessed as unroadworthy and temporarily roadworthy reached its historic maximum. However, this is closely related to the activity of supervisory authorities that has a significant impact on the specific technical inspection stations that were inspected. The progress in assessing the vehicles as unroadworthy and temporarily roadworthy for operation in road traffic was recorded on each technical inspection station on which expert supervision was carried out.

It can be concluded that the introduction of technical means for detecting infringements in the operation of technical inspection stations as well as the control activity have a demonstrable direct impact on more consistent and higher performance of technical inspection stations and thus ultimately on road safety.

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