



The effects of the preventive campaign “cautious drivers watch for level crossings” on road traffic safety in the Republic of Srpska

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Abstract: Railway level crossings represent critical points in the road traffic safety system, where serious incidents with severe consequences occur despite the presence of prescribed signaling. From 2021 to 2025, the Republic of Serbian implemented a multi-sector preventive initiative entitled “Cautious Drivers Watch for Level Crossings”, aimed at raising awareness among road users and reducing the number of extraordinary events at railway crossings. This paper analyzes the effects of the campaign through statistical data on the number of fatalities and injuries, as well as through the results of monitoring driver and pedestrian behaviour at crossings with different levels of protection. Special emphasis is placed on the role of local communities and cooperation with institutions in identifying high-risk locations, eliminating unsafe railway crossings, and educating the public. The presented results highlight the importance of continuous communication, systemic cooperation, and consistent enforcement as prerequisites for improving safety at railway level crossings.

Keywords: railway level crossings, road traffic safety, local communities, preventive campaigns

INTRODUCTION

Rail crossings are critical points in the traffic safety system, where despite the prescribed signage and technical infrastructure, serious traffic accidents with serious or fatal consequences occur. The European Union in 2022, more than 600 fatalities were recorded at road crossings over the year, with over 95% of these events being caused by human factors, most often by non-compliance with traffic regulations by road vehicle drivers (Cheng et al., 2023). Similar trends have also been observed in the Western Balkans region, where rail crossings represent a weak point of the security system, both due to insufficient technical equipment and due to insufficient awareness of traffic participants.

In Serbia, for example, in the period from 2018. by 2022. more than 200 accidents on railway crossings were recorded, with 33 fatalities – which confirms that in the

region such locations have a disproportionately high security risk (ABS, 2023).

In order to improve security at these sites, targeted preventive activities are being carried out across Europe and the world. In the United States, the “Operation Life-saver” program reduced the number of fatal outcomes by more than 40% during the first decade of application. According to data FRA, in past years recorded is more from 2.000 incidents annual on produžni crossings, what confirms need for continuous merama promotions security (Federal Railroad Administration, 2022). In Canada, Rudin-Brown et al (2014) analyzed traffic accidents at uncontrolled, rural rail crossings in 2003-2012, and identified nine dominant human factors as the cause – from reduced visibility to distraction and driver fatigue.

Within the framework of the European SAFER-LC project (2017-2020), which included 17 partners, 48 mea-

sures were developed to improve security at provided crossings, including technological solutions, video surveillance, anti-trespass panels and psychological interventions aimed at changing behavior. Research from the SAFER-LC project has also shown that a combination of technological solutions (e.g. video surveillance, sensors, DSRC communication) and behavioral interventions (visual alerts, training) are the most effective approach to risk reduction (SAFER-LC, 2020). According to the European railway agency (ERA), 224 people died in the EU at crossings in 2023. 71% of all incidents occurred at uncontrolled or light-controlled crossings without bumpers (MDPI, 2023). Selcat studies from 2008. they found that no-bumper crossings were still the most risky, with human factor accounting for 29% of direct causes. Modeling based on Poisson and negative binomial approaches is increasingly used as a reliable basis for identifying and prioritizing measures. In addition, the application of statistical models such as *Poisson* and *negative binomial* it demonstrated high reliability in predicting the frequency of accidents and in determining priority crossovers for intervention (Saccomanno et al., 2006; Elias and Bell, 2007).

In Studios from Lithuania (Gailienė and SAR., 2013) Al-Baqarah Su data American and European statistics, according to Kojima is the United States period 2006–2010 annual bilo over 2000 nezgoda on produžni crossings the EU more from 400 mortal cases, PRI what is human factor cause in over 90% cases. In Croatia, a study by the Zagreb FPZ (Starčević, Barić and Pilko, 2023), involving 185 experts, showed that combinations of technical and educational measures-especially those aimed at the youngest – are among the most effective in reducing risk.

In the Netherlands and Belgium, the application of anti-Trespass panels resulted in a 30-90% reduction in illegal track crossings in the initial period and up to 78% in three months, with long-term effects maintained at a level of 2% re-behaviour (Rosehill Rail, 2023).

According to a study published in the journal *Safety* The European Union is 2023. a year recorded 224 deaths and 176 serious injuries at rail crossings, with as many as 71% of incidents occurring at uncontrolled or light-controlled crossings without physical barriers (Cheng et al., 2023).

In the Republic of Srpska, as a response to frequent extraordinary events at rail crossings, 2021. a year ago, a campaign was launched called "Beware of rail crossings". The campaign was implemented by the Ministry of transport and communications of the Republic of Srpska, the Ministry of internal affairs of the Republic of Srpska, the Transport Security Agency of the Republic of Srpska, the Republic administration for inspection Affairs-Inspectorate of the Republic of Srpska, Railways of the Republic of Srpska, PE "roads of the Republic of Srpska", Auto-Moto Federation of the Republic of Srpska, and local self-government units, with the aim of reducing the number of traffic accidents and raising the

level of awareness of participants in traffic. Activities included field tours of critical crossings, meetings with representatives of local self-government units through whose territory the railway infrastructure passes, distribution of educational material, counting the behavior of drivers and pedestrians at railway crossings with different levels of insurance, and a media campaign in local communities.

Data collected during the implementation of the campaign from 2021. by 2024. the years indicate certain positive developments, but also the need for further institutional strengthening, technical investments and formalization of cooperation between all actors. A special role in this process belongs to local communities, which have data on risk sites, manage a significant part of the infrastructure and directly participate in informing citizens.

The aim of this paper is to analyze the effects of the campaign "careful attention to rail crossings", show the role of local communities in its implementation, compare the results with similar initiatives in Europe, and offer recommendations for improving security at rail crossings in the Republic of Srpska in the coming period.

METHODOLOGY

The work relies on data and documentation collected within the preventive campaign "careful attention to rail crossings", which were in the period 2021-2024. the relevant actors in the field of traffic safety in the Republic of Srpska have implemented for years. Primary data sources include:

- internal reports of the Transport Security Agency,
- statistics on extraordinary events of Railways of the Republic of Srpska,
- results of field activities (counting the behavior of participants at crossings),
- media and educational reports on the implementation of the campaign.

For the sake of note, the data for emergency events include only those cases of a train running into a road vehicle or other participant in traffic.

This paper will present the results of the analysis of traffic counts and monitoring of the behavior of participants in traffic in 2024. years. The analysis includes 34 cross-border crossings in 10 local communities, divided by type of insurance (higher or lower level of insurance). In total, almost 14,000 observations of the behavior of drivers and pedestrians were made, with a record of whether they complied with the prescribed signage. Additional data on emergency events and incidents at crossings in the period 2020-2024 were analyzed. years.

The data were analyzed using a descriptive and comparative method, with particular reference to:

- frequency of non-compliance with rules by type of transition,

- the effects of time continuity of the campaign,
- and the role of the local community in organizing and adapting activities.

RESEARCH RESULTS

Field count results from 2024. years at 34 railway crossings in the Republic of Srpska show marked differences in driver behavior depending on the level of insurance.

At rail crossings with a higher level of insurance – i.e. those equipped with light-sound signaling and half

– guards-extremely low non-compliance was observed: a total of 16 recorded violations on more than 8,594 samples, which represents only 0.18% of violations, and it is visible on Figure 1.

On the other hand, in Figure 2. crossings provided exclusively by traffic signs and the visibility triangle (lower level of insurance) were shown, where a total of 1,488 violations were recorded on 5,270 passes, meaning that every fourth to fifth driver (28.23%), did not pay attention to traffic signage. These data clearly indicate the necessity of additional technical interventions at critical

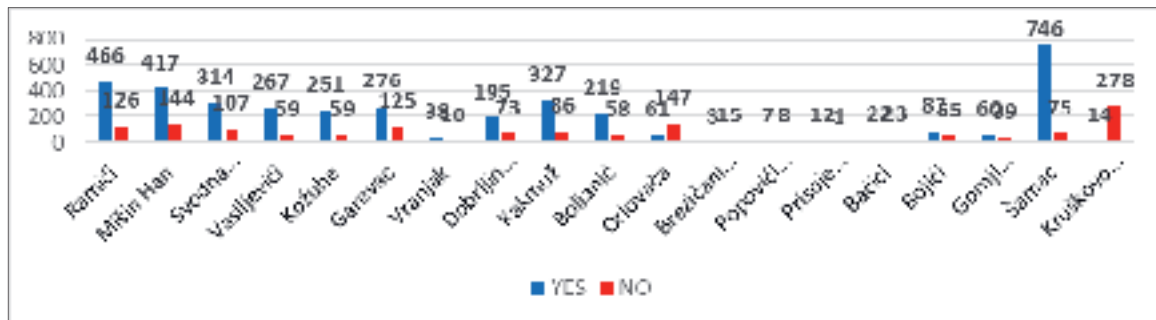


Figure 1. Counting traffic at rail crossings with a higher level of insurance

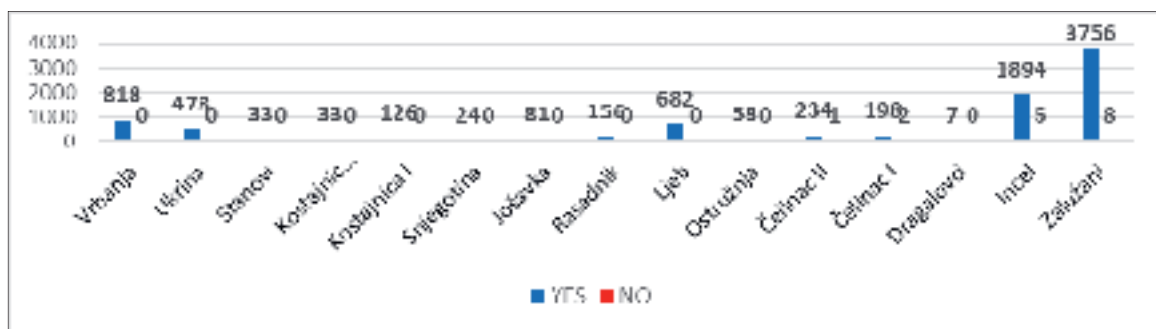


Figure 2. Counting traffic at rail crossings with a lower level of insurance

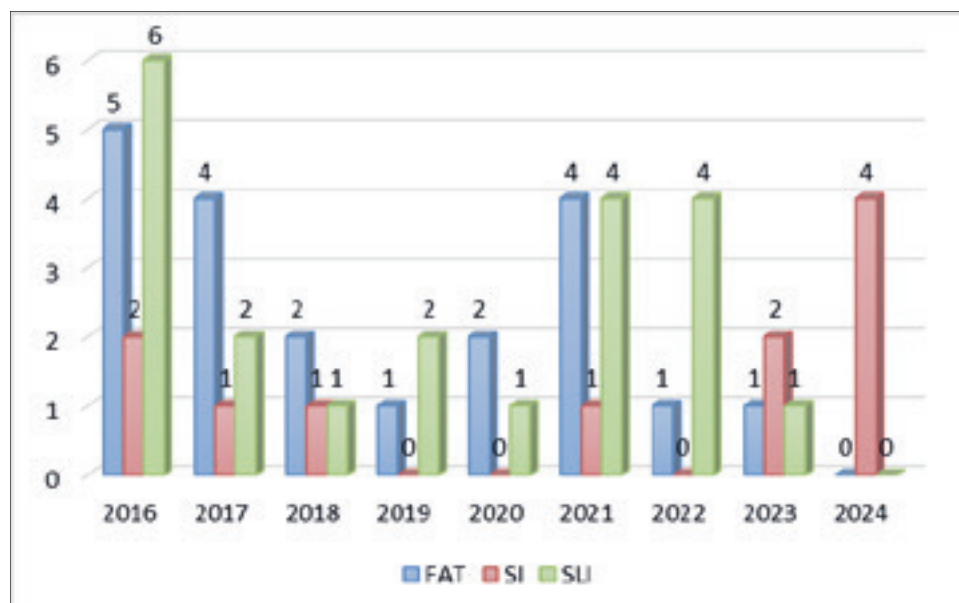


Figure 3. Structure of emergency events

sites and confirm that the human factor, in conditions of poor infrastructure support, significantly increases the risk of accidents.

As for emergency events, in the period from 2020. by 2024. in 2020, the number of traffic accidents on railway crossings was reduced from 11 to 4, with the number of deaths reduced from 4 (2020) to 1 (2024), and the number of seriously injured from 7 to 2. Although these are relatively small absolute numbers, the downward trend indicates a potential positive effect of a preventive campaign.

On Figure 3. the structure of extraordinary events in the observed five-year period is presented, according to the categories of consequences: killed persons (POG), severely injured persons (TTP) and lightly injured persons (LTP). The number of dead and seriously injured is the highest in 2021. years, followed by a significant decline. By 2024. for the first time, no deaths were recorded, and the number of minor injuries was reduced to zero.

The results indicate that the greatest effects were achieved in local communities that demonstrated the highest level of cooperation, supported field activities and integrated the campaign into their educational programs.

DISCUSSION OF RESULTS

The behavior of road users varies significantly depending on the location of the crossing and the level of technical security. Figures 1 and 2 show the number of drivers who obeyed (yes) or failed to comply with (no) regulations when crossing the railway at different crossings.

When it comes to crossings with a higher level of insurance (equipped with light-sound signaling and half-guards), the highest number of violations were recorded at The Incel rail crossing and in Zalugani, which indicates that the presence of equipment does not exclude risky behavior, especially in zones with high exposure and vehicle flow. In contrast, in most other transitions of this type (e.g. No violations of the rules have been recorded.

At transitions with lower levels of insurance (insured by signs and a visibility triangle), violations were significantly more common. Kruškovsko Polje stands out in particular, where as many as 278 of the 292 drivers ignored regulations, as well as Orlovača and Brezičani station. Data obtained from field observation and Accident Analysis indicate that the activities of the campaign "careful attention to rail crossings" had a measurable impact on reducing the risk at rail crossings in the Republic of Srpska. The reduction in the number of dead and injured, as well as the high percentage of correct behavior in most locations, indicate that the campaign has not only remained at a symbolic level, but has managed to reach citizens.

These results are consistent with the findings of the SAFER-LC project, which highlights the importance of combining technical and behavioral measures to improve safety at crossings. Comparable data from Poland, Croatia and Lithuania also suggest that multisectoral campaigns, when well targeted and consistent, can lead to concrete results. In particular, in Poland, the program "Bezpieczny Przejazd" has become a long-term part of the education and media system, which has significantly reduced the number of incidents at rail crossings (PKP Polskie Linie Kolejowe S. A., 2024).

Differences in behavior at individual crossings in the Republic of Srpska indicate the importance of adapting activities to the specificities of the place. At rail crossings where high levels of proper behavior were recorded, it is assumed that campaigns were better coordinated with local structures, media or schools. In contrast, high levels of rule-breaking indicate the need for a more intensive and targeted approach.

In addition, the results confirm the findings of FPZ research in Croatia (Starčević and associates, 2023) which recommend combining education, technical equipment and sanctions as the most effective model of action. It is shown that not only physical infrastructure is sufficient, but that a key role is also played by continuous communication with participants in traffic, tailored to the place and target group.

Although progress is visible, it is necessary to institutionalize cooperation between the Ministry of Interior, Railways, municipalities and educational institutions, and to develop a single action plan for risk crossings, based on risk assessment models such as those applied within SAFER-LC or in Lithuania. In this way, it is possible to maintain the achieved results and improve them in the long term.

CONCLUSION

Campaign "careful attention to rail crossings", implemented in the Republic of Srpska in the period 2021-2024. the year, is an example of an integrated preventive activity that included fieldwork, education, media promotion and technical interventions. The results of the analysis indicate significant positive effects: the number of traffic accidents decreased, the number of dead persons decreased, and the behavior of road users, especially in local communities that actively participated in the campaign, significantly improved.

These results support the conclusions of previous research conducted within projects such as SAFER-LC, where it was confirmed that multimodal interventions – technical, behavioural and institutional – have the greatest potential for Risk Reduction at cross-border crossings. The comparison with experiences from Croatia, Poland, Lithuania and the United States further confirms that the results are not accidental, but can be interpreted

as a product of a well-planned and directed preventive policy.

It is particularly significant that the positive effects are most pronounced in communities where the campaign has had the support of local institutions, the media, schools and the civil sector. This indicates the importance of adapting activities to a specific local context, which is in line with modern principles of Traffic Safety Management. Differences in behavior at different crossings show that a uniform approach is not sufficient, but that interventions must be based on risk analysis and actual data on participants' behavior.

Also, this campaign highlighted the potential of field counting, behavioral observation and engagement of the local community as useful tools not only for diagnosing problems but also for changing the culture of behavior. The experience of the Republic of Srpska can serve as a model for other countries in the region, but at the same time indicates the need for further institutionalization of cooperation between security subjects – from the railway sector, through the police and municipalities, to educational and media subjects.

Based on the conclusions drawn, it is necessary to continue and expand the existing activities and improve them by establishing systemic mechanisms for monitoring, analysis and risk management at the provided crossings. Only through such an approach is it possible to ensure permanent improvement of safety and improve the culture of behavior of all participants in traffic.

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