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ASSESSMENT OF THE DEGREE OF SAFETY AT RAILWAY CROSSINGS IN SERBIA CONDUCTED BY DRIVERS

Sandra KASALICA[1]
Goran TRIČKOVIĆ[2]
Milan MILOSAVLJEVIĆ[3]
Dušan JEREMIĆ[4]
Dušan VUJOVIĆ[5]

Abstract – *The approach to this research consists of conducting a field survey of drivers in Serbia in order to collect data based on which this paper assessed the driver's knowledge of the level of safety at railway crossings. The survey provided a sample of 389 questionnaires at 15 railway crossings in different cities in Serbia. The aim of this paper is to investigate the subjective sense of driver safety, their knowledge of the local railway crossing, trust in the existing protection systems, as well as their assessment of the need to upgrade the level of protection, installing video surveillance and the use of some advance warning signs*

Keywords – railway crossing, field survey questionnaire, safety, drivers

1. INTRODUCTION

Active warning devices increase the level of safety at a railway crossing relative to passive crossings, but because exposure at active crossings is higher than at passive crossings, the accident rate is still high. The perceived credibility of the warning system is determined not only by the waiting time but also by the number of false alarms or missed signals. Even though both false alarms and missed signals contribute to the drivers' perception of the warning signals' reliability, generally false alarms at grade crossings result in a lack of compliance whereas missed signals lead to more cautious behavior [1]. Wilde, et al. [2], recorded the signal reliability of active warning devices as part of his observational study of incidents at grade crossings, as previously described. The data indicated that false alarms at the grade crossings observed were relatively infrequent.

Limited sight distance to the crossing, along the track when approaching the crossing or when stopped at the crossing, hinders drivers' ability to detect an oncoming train and is a critical accident factor at passive grade crossings. Sight restrictions limit the time available for the driver to respond to the grade-crossing situation and affects drivers' ability to judge the speed and distance of an approaching train where cues regarding time and distance are more available with an unrestricted lateral view. Additionally, the site could be physically improved by removing visibility obstructions [1].

Observations of driver looking behavior at grade crossings suggest that drivers do not usually consider sight limitations a problem. Wigglesworth [3] observed driver behavior at one passive grade crossing with limited sight distance at three of the four quadrants. Surprisingly, he found no difference in looking behavior between drivers traveling in either direction.

Some drivers do not realize they are approaching a grade crossing. Driver detection of the grade crossing is difficult at night if it is not illuminated, and physical characteristics of the crossing may limit its visibility. Both these factors delay detection and recognition of trains at or approaching the crossing and may contribute to approximately 10 percent of all crossing accidents [4].

Drivers who are familiar with a crossing have an expectancy about the likelihood of encountering a train at that crossing. If expectancy is low, then the driver who is familiar with the crossing will be less likely to detect a train at that crossing than a driver who is unfamiliar with the crossing or a driver who frequently encounters trains at that crossing [4].

[1] Academy of Technical and Art Applied Studies Belgrade, department High Railway School, sandra.kasalica@gmail.com
[2] Academy of Technical and Art Applied Studies Belgrade, department High Railway School, tricko86@gmail.com
[3] Academy of Technical and Art Applied Studies Belgrade, department High Railway School, mimilan89@gmail.com
[4] Academy of Technical and Art Applied Studies Belgrade, department High Railway School, jeremicd@gmail.com
[5] Academy of Technical and Art Applied Studies Belgrade, department High Railway School, dulevoz@gmail.com

As the warning time increases, the number of violations also increases. The waiting time was a significant variable in high violation rates at grade crossings [5]. Similarly, in the study [6], the number of violations to the vehicle arresting barrier lights increased as the warning time at the crossing increased. The mean warning time at the crossing was 55 seconds, with an overall range from 26 seconds to 93 seconds. No violations occurred when the waiting times were less than 20 seconds because the barrier nets and gates began to lower within this time interval. However, the number of violations increased by approximately 10–15 percent for every 10 second delay beyond 20 seconds.

Enforcement of grade crossings can occur via one of two methods: a traditional traffic stop, in which a law enforcement officer witnesses a violation and issues a citation to the driver in person; or automated photo enforcement, in which violations are detected via a sensor and captured on film and the appropriate law enforcement authority issues a citation via mail [5].

Public education can inform drivers of the dangers at grade crossings and of the actions required. Rules specifying driver actions at grade crossings vary from state to state, and some states do not even discuss grade crossings in their driver education manuals [7].

2. METHODOLOGY

Focus group surveys or interviews are one way that can be used to gather information on driving behavior at railway crossings. Roy Morgan research [8] surveyed 4,402 drivers and identified the significant role of inattentiveness in increasing rail crossing risks.

Davey et al. [9] made semi structured focused group interviews to 53 young drivers from a regional and metropolitan settings drivers self/reported behaviors, attitudes, and knowledge at railway crossings were explored.

A survey questionnaire that asks motor vehicle drivers' inattentive driving experiences, knowledge, attitudes, and expectations towards safety at railway crossings can be very useful in explaining inattentive driving behaviors. The project [10] investigated motor vehicle drivers' characteristics, their perceptions of safety at crossings, understanding and comprehension of traffic signs/signals at crossings, and their self-reported unsafe maneuvers at railway crossings in many cities of Nebraska. A three-stage mail contact survey design was used. Analysis of the survey responses showed that drivers generally had good knowledge of safely driving at railway crossings.

The approach to this research consists of conducting a field questionnaire survey of drivers in Serbia to collect data on perception of drivers at the local railway crossings.

Tab. 1 presents a list of questions from the survey questionnaire for surveyed drivers that were used to assess the level of safety at railway crossings.

Tab. 1. List of survey questions

No	Questions
1.	I do not trust the signalization at the railway crossing in my city (e.g., flashing lights, half gates, gates, etc.)
2.	I feel unsafe when driving at railway crossings in my city.
3.	I believe that it is necessary to upgrading the level of protection systems at the railway crossing (e.g., flashing lights, half gates, gates, etc.)
4.	I think I have been waiting too long for the train to arrive.
5.	I think that the railway crossing is not well–lit at night.
6.	I think video surveillance at the railway crossing would be useful for upgrading the level of safety.
7.	I think some other advance warning signs would be useful.
8.	I think that sight distances are not well–provided.
9.	I think that crossing surface is not in order due to damage.
10.	I think I know well the railway crossing I use most often.
11.	I have never received information on railway crossing safety.
12.	I support stricter legal regulations related to irregularities in the behavior of drivers at railway crossings.

The survey was conducted at 15 railway crossings, one railway crossing in Kraljevo, Paracin, Batocina and Stepojevac, two railway crossings in Backa Topola and Dimitrovgrad, three railway crossings in Negotin and four in Smederevska Palanka and its surroundings.

The survey was conducted at 15 railway crossings, where, 13 where active railway crossings, one passive and one with a crossing guard. A total of 389 drivers were surveyed.

3. SURVEY RESULTS

Tab. 2 presented a summary of the responses of the twenty single choice questions. A participiant was given a score, from 1 to 5, for each of the above 12 questions. For example, if a driver chose score 1 it means that the respondent "does not agree at all" with the statement in question, that is, if the driver chooses a grade of 5, it means that he "completely agrees" with the statement in question.

For the purposes of analyzing the obtained survey results in the Tab. 3 are summarized score 1 and 2,

which mean that the surveyed drivers do not agree with the statement in question. Scores 4 and 5 are also summarized, which means that the surveyed drivers agree with the statement in question. A score 3 means that the surveyed drivers are neutral regarding the statement in question.

Tab. 2. Survey results related to the assessment of the level of safety at railway crossings

Σ surveyed drivers 389		Score				
		1	2	3	4	5
Questions	1	144	56	93	46	50
	2	132	70	92	39	56
	3	72	29	63	43	182
	4	42	50	92	55	150
	5	86	35	122	71	75
	6	26	16	47	49	251
	7	70	21	64	60	174
	8	84	49	128	57	71
	9	118	56	86	43	86
	10	11	22	82	79	195
	11	35	18	68	63	205
	12	24	11	57	44	253

To the first question, which refers to the trust in the signalization at the railway crossings processed in the surveys, more than half of the surveyed drivers answered that they have confidence in the signalization that is installed at the given crossings. Drivers in Backa Topola and Smederevska Palanka showed distrust and neutrality in the signalization.

The subjective feeling of safety of crossing the railway crossing was assessed similarly to the first question. Half of the drivers feel safe while crossing the railway crossing. Neutrals and drivers who feel unsafe are again drivers in Backa Topola and Smederevska Palanka.

At 14 out of 15 railway crossings, the surveyed drivers mostly agreed that the level of protection systems at the railway crossings need to upgrading except for drivers in Stepojevac who are satisfied with the level of protection of railway crosing in that place.

The actual warning time provided at a crossing, or the time available between device activation and train arrival, completely agrees with the answers to the fourth question. At railway crossings where the real waiting time is over one minute, drivers feel that they have been waiting too long for the train to arrive. This is particularly expressive at the railway crossings in Negotin, Batocina, Backa Topola and Dimitrovgrad.

The question related to adequate lighting of the railway crossing was assessed as fairly uniform. 38% of drivers stated that railway crossings are not adequately lit, while other drivers are equally neutral or satisfied with the lighting of railway crossings.

Tab. 3. Survey results related to the assessment of the level of safety at railway crossings (in percent %)

Σ surveyed drivers 389		Score		
		Disagree	Neutral	Agree
Questions	1	51%	24%	25%
	2	52%	24%	24%
	3	26%	16%	58%
	4	24%	24%	53%
	5	31%	31%	38%
	6	11%	12%	77%
	7	23%	16%	60%
	8	34%	33%	33%
	9	45%	22%	33%
	10	8%	21%	70%
	11	14%	17%	69%
	12	9%	15%	76%

It is interesting that as many as 77% of surveyed drivers answered that video surveillance at railway crossings would be useful due to upgrading the level of safety. This is especially expressive at railway crossings in Negotin, where over 95% of surveyed drivers are in favor of installing video surveillance at railway crossings.

On the seventh question, 60% of the surveyed drivers agree that an additional insurance system would be useful for raising the level of safety at the railway crossing. The exceptions are Kraljevo and Dimitrovgrad, where the surveyed drivers think that the current insurance system is satisfactory.

From the eighth question, it can be seen that at railway crossings where, in addition to road signs, there are also half gates or gates, the sight distances does not greatly affect drivers. Only the surveyed drivers in Negotin, at the railway crossing which is provided only by road signs, stated in large numbers that the sight distances is very important.

45% of respondents said that the crossing surface was in order, 22% were neutral, while 33% of the respondents said that was unsatisfactory. Respondents at the one railway crossing in Negotin and Backa Topola and two railway crossings in Smederevska Palanka spoke in particular about the unsatisfactory situation.

70% of respondents answered that they know well the road crossing they use most often. This is in accordance with the answers of the respondents regarding the frequency of use of railway crossings. Namely, at 11 of the 15 railway crossings, the respondents stated that they use the railway crossing daily or several times a week.

The majority of respondents 69% answered that

they have never received information on safety at railway crossings, while 17% are neutral on this issue. This indicates the need for a public educational campaign of road traffic participants regarding the behavior and traffic safety at railway crossings in Serbia. For now, only the campaign on safety at railway crossings is being conducted by the "Serbian Railway Infrastructure" in cooperation with the Media Center "Serbian Railways" among primary school students in Serbia.

Also, the majority of respondents, 76% support stricter legislation related to irregularities in the behavior of drivers at railway crossings. This indicates the fact that the driver's awareness of this issue is present. Unfortunately, it probably occurs as a result of accidents that occur at railway crossings that drivers are informed about through the media.

4. CONCLUSION

Generally it can be concluded that the respondents have a good knowledge of local crossings in terms of the questions in the survey.

More than half of the respondents think that they have been waiting too long for the train to arrive, which is in accordance with the actual waiting times at those railway crossings. This leads us to the conclusion that waiting too long could be one of the causes of distrust in signalization, subjective feeling of insecurity, as well as their assessment that it is necessary to upgrading the level of protection systems at railway crossings.

Also, most respondents answered that video surveillance, as well as some advance warning signs would be useful to upgrading the level of safety at railway crossings.

As we could have assumed, the sight distance of the railway crossing was important to the drivers at the passive railway crossing, while the drivers at the active railway crossings answered that sight distance was not important or they were neutral. This is in accordance with [5]. Namely, the availability of quadrant and track sight distances is less important when concerned with active traffic control; however, the drivers ability to see the train while hi is approaching the crossing may give the drivers more time to contemplate whether to violate or complay and thus, influence the drivers tendency to violate.

Most drivers believe that they have a good knowledge of railway crossings, which was to be expected given their frequent use.

In general, drivers are not satisfied with information on safety at railway crossings, as well as with the existing legislation related to irregularities in the behavior of drivers at railway crossings.

One of the proposals for increasing safety at railway crossings could be to educate the population on behavior at railway crossings. In that education should be included, first of all, driving schools that would spend more hours on this topic, agencies dealing with traffic safety, railways and the media that would point out the behavior of participants at railway crossings to indicate their irregular behavior in order to wake up awareness of traffic participants about the importance of this problem.

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