

SELECTED ISSUES IN RAIL TRANSPORT SAFETY IN POLAND

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Abstract: Safety in rail transport is a problem that many countries are struggling with. Rail transport is one of the main areas of Poland's economic development. The authors analysed and interpreted statistical data on the condition of the railway infrastructure and rail safety, as well as identified the main causes of railway accidents. The development of rail infrastructure has a significant effect on freight and passenger transport safety. Among the most serious hazards in rail traffic are accidents and rail collisions. The most frequent rail accidents occur at level crossings, where those responsible are motor car drivers. There is a clear trend showing a decrease in the number of accidents with an increase in the percentage of well-preserved rail lines. This situation is a consequence of social awareness.

Keywords: safety, rail transport, rail accidents, rail infrastructure.

1. Introduction

Rail transport has been operating around the world for many years. The period between the second half of the nineteenth century and the first half of the twentieth century may be considered ground-breaking for its development. The first railroad of a public nature was opened in 1825 in Northern England, where the 15-km line joined Stockton and Darlington. In 1835, a railroad connecting Nuremberg and Furth was launched, then in 1838, the Berlin-Potsdam and St Petersburg-Tsarskoye Selo rail lines were constructed. Rail transport reached Poland as late as in 1842, when it first joined Wrocław and Olawa. The first train entered Poznań a couple of years later, i.e. in 1848. Nowadays, rail transport is very common and used for the transport of both goods and passengers (Wojciechowski et al., 2009, p. 238). Since its beginnings, railways have played a crucial role in transportation. They carry freight and people between cities. Rail transport is a meaningful element of our country's economic development. This is demonstrated through its economic and environmental features. The integrated

undertakings of every rail entity currently operating on the market, in addition to financial resources, can lead to effective attainment of goals. Strong development efforts and investment outlays in the rail sector should produce the desired business results and socio-economic benefits.

2. Rail Transport in Poland

Rail transport is one of the main branches of land transport, based on the transport of goods and the population via the use of rail transport means. The main characteristics of rail transport include (Stajniak et al., 2008, pp. 28-29):

- bulk transport capacity,
- low fares for medium and long distances,
- a relatively extensive network of rail lines well-adjusted to main market and outlet locations,
- an offer advantageous in terms of transport duration, which is an effect of THE high reliability of rail transport and the regularity, frequency and rhythm of train connections offered,
- professional railway rolling stock for the transport of freight of differentiated transport vulnerability, i.e. goods' resistance to the conditions and consequences of transport,
- provision of transport to other transport branch carriers,
- rail transport is the most ecological form of transport, thanks to which it significantly contributes to environmental protection.

Efficient rail transport operation requires the co-existence of a well-prepared and passable infrastructure and railway rolling stock. The rail sector infrastructure may be divided into linear and point (station). Point infrastructure is composed of: points of operations, i.e. traffic posts and expedition points. Linear infrastructure consists of elements of the rail route (Kwaśnikowski et al., 2010, p. 79).

According to the data of the Rail Transport Office (UTK), at the end of 2017, the total length of rail lines in Poland was 19,132 km, including 11,874 km of electrified lines. The state average rail line density was 6.17 km/100 km², compared to 6.14 km/100 km² in 2016. The largest rise in the length of lines was observed in the Podlaskie Province and amounted to 80 km. A clear increase was also noted in the West-Pomeranian and Małopolskie Provinces – 19 km and 18 km, respectively. The greatest drop was seen in the Silesian Province, where the length of lines decreased by 21 km. The largest share in the rail network is owned by the Silesian Province (10.1%), whereas the smallest one – the Świętokrzyskie Province (3.7%).

The chief manager of railways in Poland is PKP Polskie Linie Kolejowe S.A., which, in the year 2017, controlled the following railway infrastructure:

- 18,513 km of rail lines – which amounts to 35,967 km of tracks, including 27,120 km of main line tracks and 8,847 km of through-platform tracks,
- 39,482 points (turnouts), including 17,950 main line points (turnouts),
- 14,442 junctions at the track level,
- 25,324 engineering facilities,
- 5,823 buildings,
- 14,108 structures.

According to the 2017 PKP Annual Report, as a result of maintenance-repair works performed and investment tasks, the length of railway tracks in good technical condition accounted for 58.9% of the total length of railway tracks. The percentages of the length of tracks in unsatisfactory and sufficient condition are 25.5% and 15.6% of the total length of tracks, respectively. In Figure 1, the technical condition assessment of railway infrastructure in Poland over the period 2010-2017 is presented.

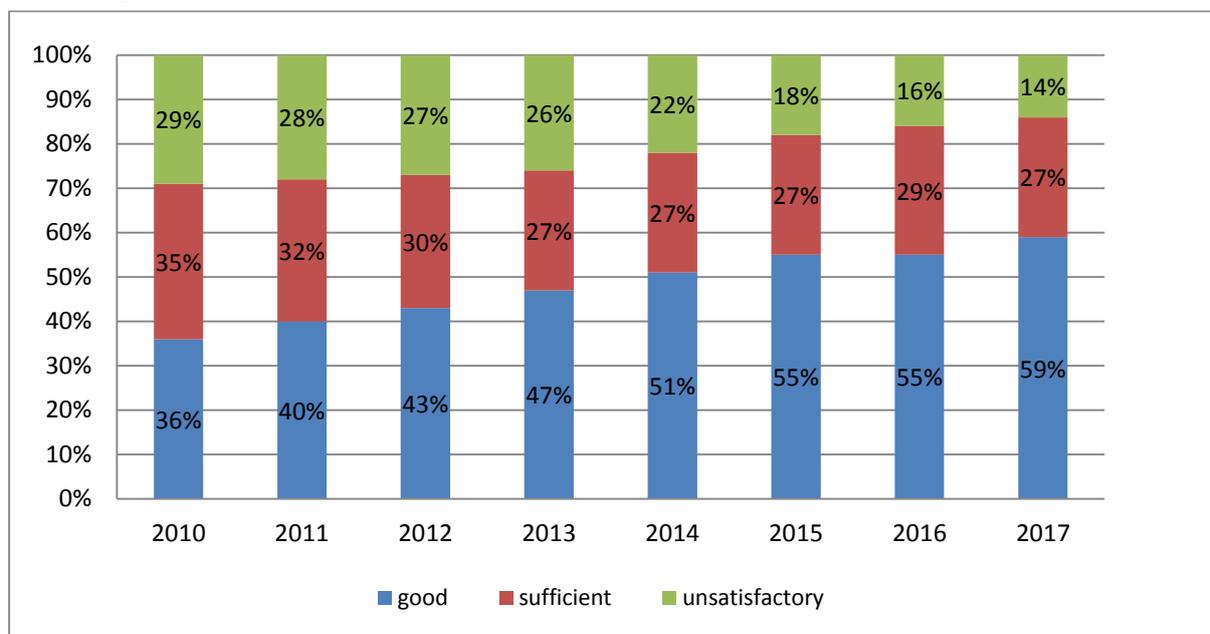


Figure 1. Evaluation of the PKP PLK railway infrastructure condition, 2010-2017. Source: Own compilation based on Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Warszawa, 2018, p. 121.

An assessment of the condition of railway infrastructure in Poland in the period 2010-2017 reveals that in the year 2010, 36% of railway lines was in good condition, whereas 64% was in sufficient or unsatisfactory condition. In the year 2017, in turn, 59% of railway lines was classified as in good conditions, and 41% of lines in sufficient or unsatisfactory condition.

According to the data of the Central Statistical Office (GUS), passenger rail transport in Poland in the period 2012-2017 fluctuated. In the year 2012, 273,182 thousand passengers travelled by rail, whereas in two consecutive years, we could observe a downward trend –

in 2014, the number of transported passengers was 268,202 thousand. Since 2015, rail passenger transport has been growing and reached 303,001 thousand in the year 2017. In Figure 2, passenger rail transport in Poland in the period 2012-2017 is presented.

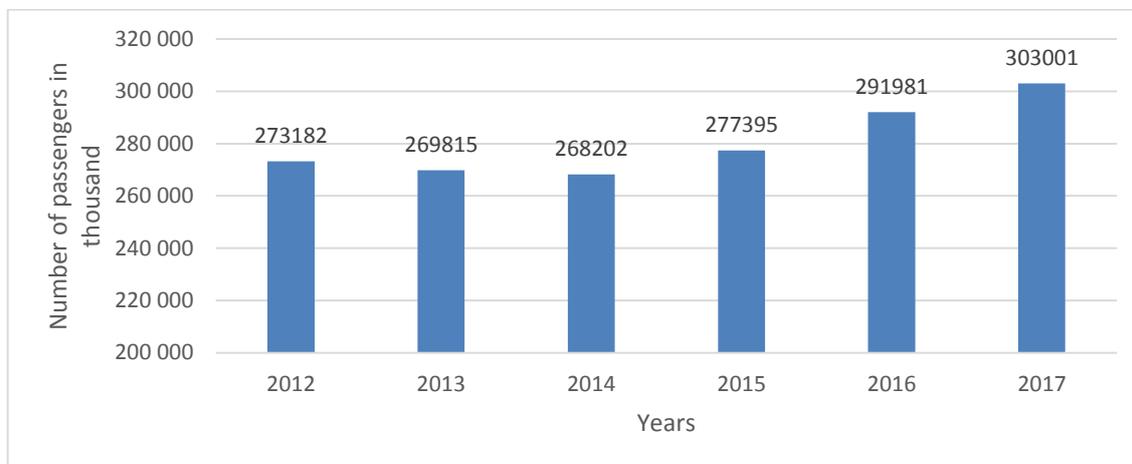


Figure 2. Passenger rail transport in Poland in the period 2012-2017. Source: Own study compiled on the basis of data from the Central Statistical Office(GUS).

Considering rail freight transport in Poland, we ought to note that in 2010, 235.3 million tonnes of goods were transported, in 2011 – 249.2 million tonnes, and since that time, the payload mass of goods transported by railway has been falling, reaching 222.2 million tonnes in the year 2016. However, the year 2017 saw an upward trend, as 239.5 million tonnes of goods were transported by rail. In Figure 3, the payload mass in freight rail transport in Poland in the period 2010-2017 is shown.

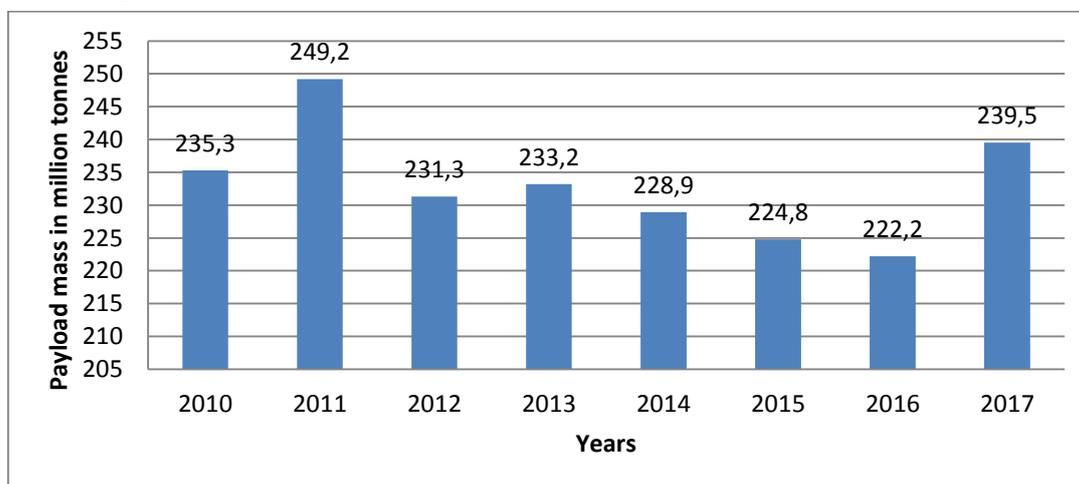


Figure 3. The payload mass in rail transport in Poland in the period 2010-2017. Source: Own study compiled on the basis of Central Statistical Office's data (GUS).

In accordance with the Ministry for Infrastructure, in the days to come, the strategic objective is to strengthen the role of rail transport in the national integrated transport system. To accomplish this, actions will be taken to positively affect the growth of railway competitiveness with respect to other transport branches, expressed by trip duration, travel comfort and the level of safety. The fulfilment of these tasks is strictly related to investment and

organisational and technological changes. In the context of rail freight transport, it is essential to provide suitable conditions for complementary services in relation to other branches of transport. Hence, emphasis should be placed on intermodal infrastructure development, which will aim at offering facilities and amenities allowing for the implementation of a complete transport chain by the provision of “door to door” services “on time”. An important aspect of the rail transport development strategy is an effective and efficient use of infrastructure, suitable to the needs of goods transport, of appropriate traffic capacity, maximum possible speed, axle load limit, loading gauge and length of tracks (Strategia Rozwoju Transportu do 2020 roku z perspektywą do 2030 (2020 Transport development strategy with a 2030 perspective)).

3. Safety in Rail Transport

A vital issue pertaining to freight and passenger transport by rail is safety. According to the Dictionary of the Polish Language, “safety” is the state of freedom from danger. Literature on the subject describes safety as the condition which is to guard life, health, property and other values protection against actions which pose threats and as the protection of the rules of co-existence in a society and relations governed by the law (Czupryński et al., 2015). On the one hand, according to W. Kitler, safety is “the condition in which a given object is that which allows it to feel safe, i.e. free from and guarded against any potential real threats, sure of an undisturbed existence and development, with the application of all measures, having a creative impact on the achievement of such a state” (Kitler, 2011, p. 23). On the other hand, R. Zięba describes safety in an all-social meaning as “the maintenance of one’s needs: the need to exist, survive, the need of certainty, stability, identity, independence and the protection of quality of life. Safety, constituting the primary need of people and social groups, is, at the same time, the major desire of states and international systems; a lack of this causes anxiety and fear” (Zięba, 1989, p. 50).

Safety in rail transport is of utmost importance. All actions must always lead to acceptable risk, and this ought to be at a level of continuous risk identification and risk management. In order to ensure rail transport safety, various groups of entities become involved: the rail carrier, infrastructure managers, siding users, rolling stock manufactures and plants managing rolling stock maintenance (Jendryczka, 2017, p. 1692). The intensive and complex development of the issue of rail transport safety management in the European Union was initiated by the provisions of Directive 2004/49/EC of the European Parliament and of the Council of 29 April 2004 on safety on the Community’s railways. The assurance of a high level of rail safety and equal conditions for all railway undertakings are subject to the same, precisely defined, requirements (Markowska, 2018, p. 316).

The major common railway traffic safety indicators are the number of railway accidents and the analysis of their causes and effects. The graphical presentation of the number of rail accidents in Poland in the period 2011-2017 is presented in Figure 4.

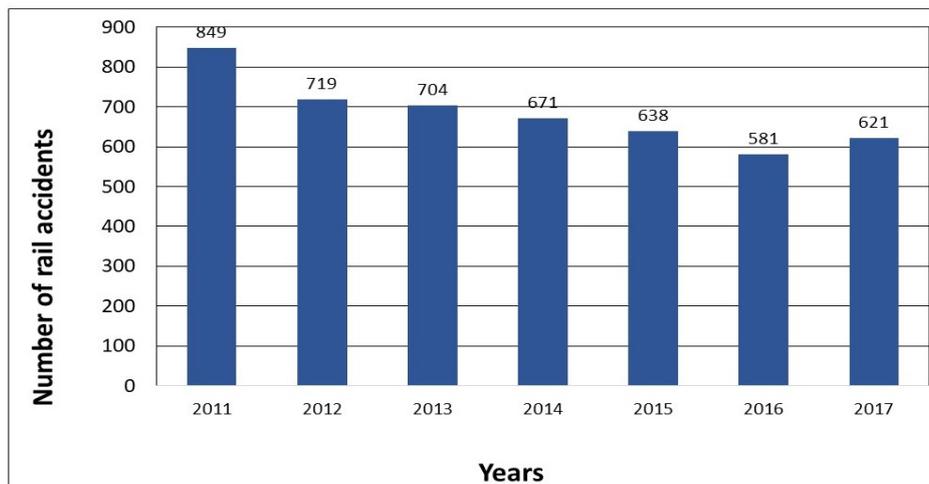


Figure 4. The number of rail accidents in Poland in the period 2011-2017. Source: Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Wyd. WSiP, Warszawa, 2018, p. 49.

Attention should be paid to the fact that the present-day trend is an increase in rail transport safety when compared to previous years. In 2017, 621 rail accidents were noted, compared to 849 rail accidents in 2011. The reasons behind this phenomenon may be minimisation of railway risks and increased awareness of people using level and pedestrian crossings.

Under the Act of 23 March 2003 on Rail Transport, rail accidents could be classified as the following types:

- train collisions,
- train derailment,
- events at level and pedestrian crossings,
- accidents to persons caused by rolling stock in motion,
- rail vehicle fires.

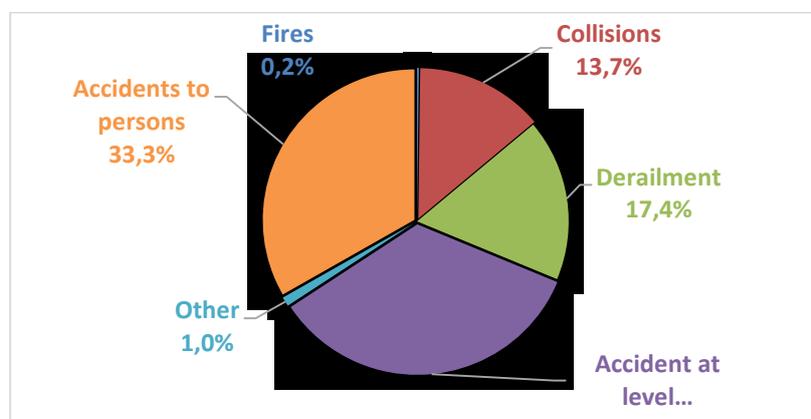


Figure 5. The number of accidents in Poland in the period 2011-2017 by type. Source: Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Wyd. Urząd Transportu Kolejowego, Warszawa, 2018, p. 50.

An analysis of Figure 5 demonstrates that the most numerous types of accidents which occurred across the rail network in 2017 were level-crossing accidents, which accounted for 34.5% of all accidents. The second most numerous group were accidents to persons caused by rolling stock in motion, which accounted for 33.3% of all accidents. Collisions and derailments amounted in total to 31.1% of all railway accidents.

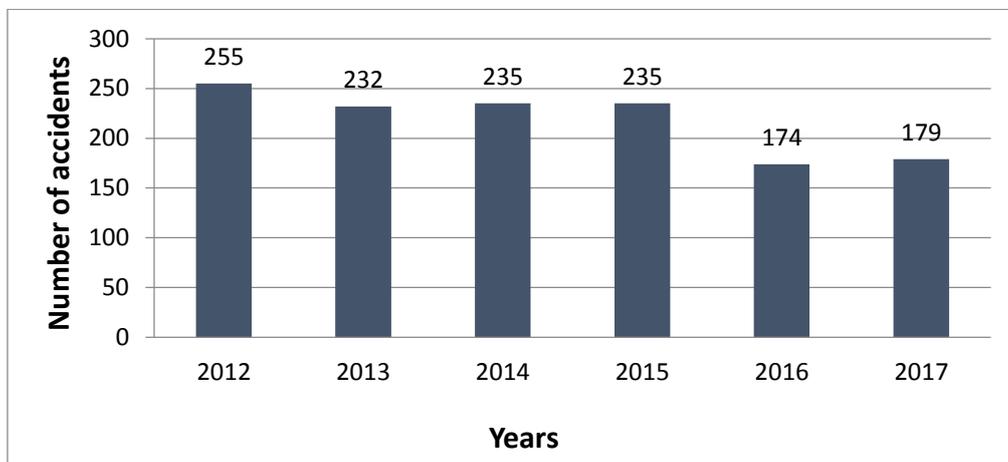


Figure 6. Total number of accidents caused by hitting persons crossing rail tracks in the period 2012-2017. Source: Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Wyd. Urząd Transportu Kolejowego, Warszawa, 2018, p. 90.

An analysis of the data in Figure 6 demonstrates that from 2012 to 2017, the number of accidents caused by a rail vehicle hitting a person crossing rail tracks dropped. In 2012, there were 255 accidents, in 2017 – 179, and the least amount was noted in 2016 – 174. It has been determined that, on average, every other day a person is hit whilst crossing train tracks at an unauthorised place.

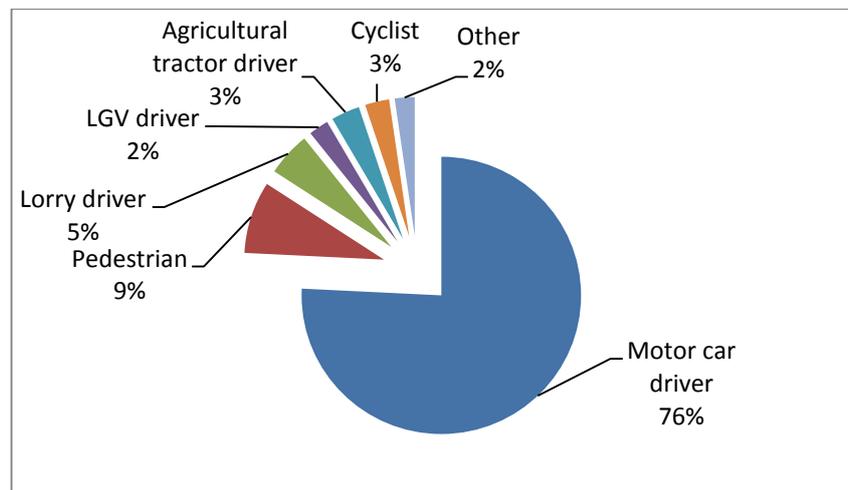


Figure 7. Percentages of individual groups of road traffic participants in level-crossing accidents in 2017. Source: Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Wyd. Urząd Transportu Kolejowego, Warszawa, 2018, p. 104.

An analysis of Figure 7 reveals that the largest group participating in level-crossing accidents in 2017 was motor car drivers (76%). The second largest group was agricultural tractor drivers.

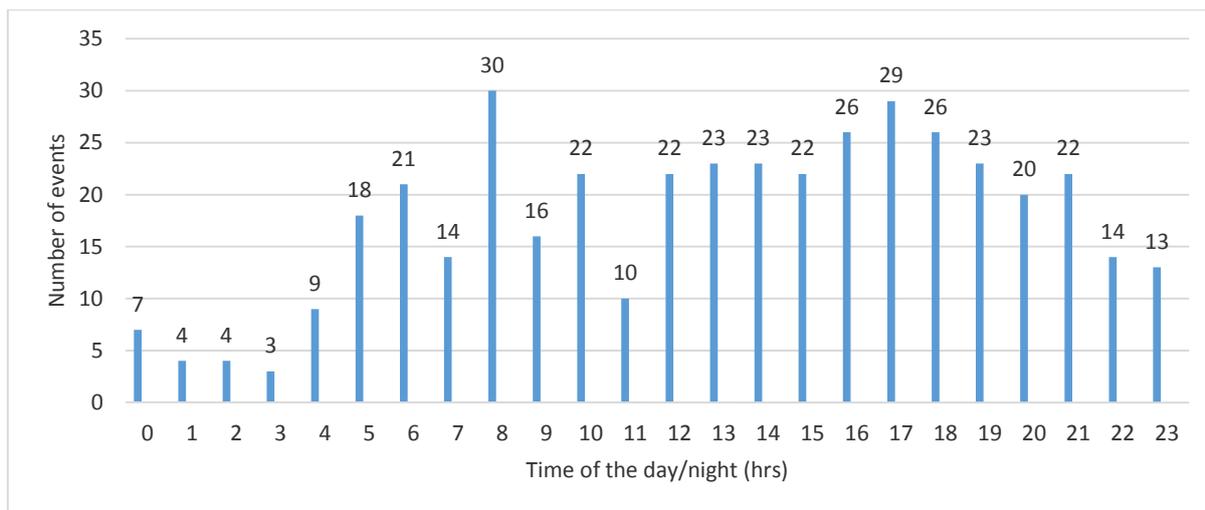


Figure 8. Level-crossing accidents and accidents to persons at certain times of the day/night in 2017. Source: Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Wyd. Urząd Transportu Kolejowego, Warszawa, 2018, p. 74.

The data presented in Figure 8 show that level-crossing accidents and accidents to persons caused by rolling stock in motion most frequently occur at 8:00 am and between 4:00 and 6:00 pm. A rise in the number of accidents past 8:00 in the morning and in the evening are mainly related to increased traffic, instance.g. due to commuters or shoppers (the so-called rush hours).

Table 1.

Fatalities and persons seriously injured in rail accidents in Poland in the period 2013-2017

	Fatalities					Seriously injured				
	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Collisions	1	9	3	0	0	1	3	3	2	11
Level-crossing accidents	52	43	55	48	42	37	25	41	39	29
Accidents to persons caused by rolling stock in motion	175	164	173	121	129	64	67	49	53	35

Source: Own compilation based on Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Wyd. Urząd Transportu Kolejowego, Warszawa, 2018, p. 60.

As demonstrated in Table 1, the number of fatalities in 2013 was 228, and seriously injured – 102. In 2017, in turn, there was a fall in the number of fatalities – down to 171, which is a drop of 25%, and a decrease in the number of seriously injured down to 87, which is approximately 15%.

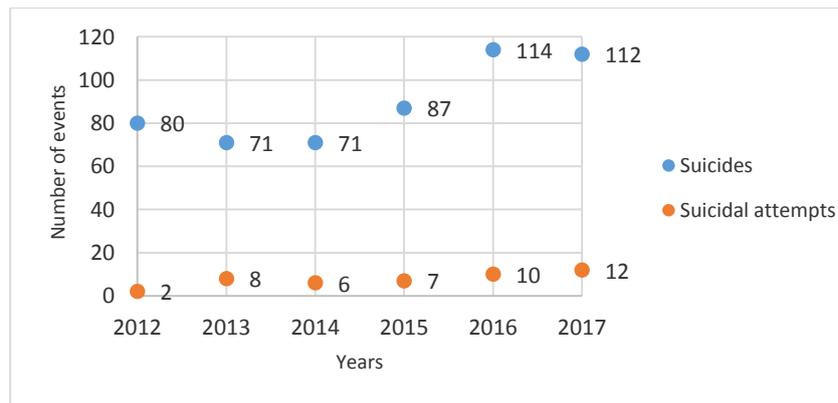


Figure 9. Number of suicides and attempted suicide in the period 2012-2017. Source: Own compilation based on Sprawozdanie ze stanu bezpieczeństwa ruchu kolejowego w 2017 roku (Report on the safety of railway traffic in 2017), Wyd. Urząd Transportu Kolejowego, Warszawa, 2018, p. 92.

An examination of the data included in Figure 9 shows that in the period 2012-2017, the number of suicides increased. In 2017, there were 124 events of this type, which in 112 cases resulted in the death of the person attempting suicide, and in 12 cases, the person was either seriously injured or hurt.

To ensure safety at a high level is a priority for the companies governed by the Minister for Transport Affairs. This goal is attained, above all, by the provision of safety standards, continuous monitoring, risk assessment, prophylaxis and employee training. The Ministry for Infrastructure in Poland is to ensure improved rail safety, principally associated with two areas (Ministry for Infrastructure, 07/04/2019):

- hard – modernisation and revitalisation of rail lines and the implementation of the European Train Control System,
- soft – modification and development of new legal texts which will concern rail safety, PKP training competencies extension through the purchase of simulators for employee training purposes.

The safety of railway traffic is overseen by the National Rail Accident Investigation Commission, which acts independently for the Minister for Transport Affairs. Its responsibilities are (Strategy of Transport Development):

- conducting proceedings following every serious rail accident, except for a train or another rail vehicle hitting a person crossing train tracks,
- conducting or supervising post-accident investigations, the objective of which is to determine the causes or the circumstances of resultant events and to formulate preventive conclusions,
- conducting proceedings referring to accidents or incidents, which under slightly differing conditions would have been considered serious accidents stalling the operation of structural subsystems or the interoperability constituents involved in the interoperability of the trans-European high-speed rail system, trans-European conventional rail system.

According to the Ministry for Infrastructure, of strategic importance for rail safety is a focus on traffic safety at level crossings. This will require orienting at interventions involving observation, or even filming, of level crossings where legal regulations are frequently breached. Another planned activity is to mark or label the particularly dangerous level crossings with boards informing about the danger and to modernise such level crossings. Another good solution is to eliminate all one-level crossings in favour of two-level crossings, overbridges (fly-overs) and tunnels (Strategy of Transport Development).

4. Conclusions

All in all, rail transport is one of the safest land transport branches. Unfortunately, the rail infrastructure requires numerous investments in the construction and modernisation of rail lines and station infrastructure, such as railway stations, sidings and many others. A strong correlation between the improving technical condition of rail infrastructure and the number of rail accidents can be observed, which may be indicative of the state's actions aimed at enhancement of the safety of the population. The most frequent rail accidents occur at level crossings, where those responsible are motor car drivers. The main cause of accidents on railways are human errors, but machines and devices, as well as the technical condition of the infrastructure, also fail. There is a clear trend showing a decrease in the number of accidents with an increase in the percentage of well-preserved railroads. This situation is a consequence of social awareness, as well as state actions for the safety of its population.

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