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Preventing SPAD Railway Incidents (Signal Passed At Danger) as an Element of Safety Culture in Railway Transport: The Example of Szybka Kolej Miejska in Warsaw

Abstract: In this article, an attempt is made to present the assumptions of safety culture in railway transport, analyze SPAD incidents occurring at Szybka Kolej Miejska sp. z o.o., and assess proactive measures aimed at minimizing the risk of railway incidents from the perspective of human factors. Considering the upward trend in SPAD (Signal Passed At Danger) incidents related to trains not stopping before a signal indicating "Stop" or in a designated stopping area, as well as their impact on the safety of the passenger transport process in terms of the serious consequences following their occurrence, it seems reasonable to analyze the causes of these incidents, to attempt to answer the question of whether the railway system is capable of drawing lessons from these situations, and to evaluate the effectiveness of the corrective actions being implemented.

Keywords: Fast City Railway; Signal Passed At Danger; Railway transport

Introduction

Rail transport is one of the essential elements of the regional, national, and ultimately global infrastructural network. It is also one of the modes of land transport most exposed to accidents and disasters, both in terms of passenger and freight operations. Ensuring safety in railway transport is one of the key conditions necessary to achieve the goal of sustainable development in the railway sector. In view of the above, every entity operating in the area under our analysis has the responsibility to maintain a level of safety that meets the required and prevailing criteria, as well as to implement improvement measures. The planned objective is not easy to achieve, and to reach it, safety must be managed in an appropriate manner—both through new systems and those based on experience. There is no doubt that the use of effective standards, which are fully compliant with applicable law and shape the safety culture in the area we analyze, is the foundation of any successfully operating railway system. Maintaining and improving the level of safety within the broadly defined safety culture pertains to a range of entities directly or indirectly responsible for railway transport, including organizations in the railway sector—railway carriers, infrastructure managers, users of railway sidings, and entities responsible for maintenance. One of the significant factors affecting the safety performance of a given railway entity is the occurrence of railway incidents.

Safety Culture of Railway Transport

In undertaking an analysis of the subject of scientific research—which encompasses the safety culture of railway transport—it is necessary first to consider the role and significance of railway operators focused on passenger transport, whose primary objective is to conduct journeys safely, with one of their aims being to provide an infrastructure that is both adequate to needs and safe. Safety culture is closely connected with the behavior of employees directly and indirectly involved in railway safety, including positions such as train drivers, train managers, and traffic controllers. The behaviors of personnel associated with safety and railway traffic management are subject to supervision based on procedures previously adopted within the railway enterprise that strictly adhere to the applicable law in this area. Railway operators have a certain degree of discretion in influencing the attitudes of employees in the broadly defined area of safety, albeit provided that a series of requirements stemming from legal norms are fulfilled. Safety culture essentially begins where the role of law in shaping the "railway reality" ends. These are actions that go significantly beyond the basic requirements. Consequently, they deserve particular attention as well as appropriate rewards (both material and immaterial) for the employees. The example for such actions should come from the leadership of the institution [5].

In shaping the safety culture in railway transport, the efficiency of these enterprises is also significant, defined as a fundamental attribute for assessing and evaluating the degree of resource management as well as the extent to which proper results are achieved across various dimensions and perspectives of organizational functioning. The formulated expectations in the area of efficiency necessitate the implementation of managerial control. Another concept that plays a key role in establishing a safety culture is organizational culture. It shapes identity and image, influences the scope and value of relationships within the organization, and sets the direction for most of its key activities. The most efficient enterprises are those characterized by a strong organizational culture, leveraging the potential of their employees and their qualifications, thus decisively influencing the high quality of managerial processes. Key factors of organizational culture can be embedded in what is known as the stream that defines the organization's successes, simultaneously serving as an element of the enterprise's strategy. The strategies developed by individual entities in the railway sector have their own distinct dimension and character, thereby constituting an effective response to the requirements and expectations of stakeholders. In every organization, the process of planning, risk assessment, and control of actions aimed at ensuring that safety is not compromised should be presented both in general and in detail (in accordance with the principle of "from general to specific"). Often, companies choose continuous monitoring instead of periodic control, which increases costs but also prevents the escalation of "pathologies" in the process of producing goods and services. It is therefore not surprising that the goals are almost inextricably linked with safety. The management team plays a key and active role in planning and implementing the necessary changes in the area of safety culture that we are interested in [8]. The development of methods, techniques, and above all, the philosophy of managing railway transport encourages reflection on the railway sector. The result of such a thought process has been the formulation of requirements for the construction and implementation of safety management systems.

Taking the above introduction into account, in a more practical dimension it is necessary to present a safety model for both individual and collective entities. This model can be viewed through the lens of the following aspects:

a) **The desired state**, which for a given entity defines the level of control efficiency over threats to values important to that entity in a given location and time frame. In other words, it is the state arising from the existing difference between two opposing factors in that area – on one hand, the potential for the entity's autonomous defense, and on

the other, the threats to the fulfillment of the entity's needs (the so-called epistemological aspect);
b) **Value**, which enables the safety entity to satisfy both its lower and higher needs, including the need for continuous development, with self-realization at the top of the hierarchy of needs (axiological aspect – Maslow's Pyramid);
c) **The process of development**, through which the personal and social aspects of the growth of the safety entity's autonomous defense potential are realized (ontological aspect);
d) **The social construct**, which enables resistance to threats resulting from the existence of social bonds, interdependencies, and interactions occurring within a social collective (social aspect) [2].

In analyzing the concept of safety in the context of managing the human and organizational factors, it should be emphasized that safety in railway transport can be divided into active safety and passive safety. Active safety is an active form of safety and, according to the definition, comprises a set of factors that influence the reduction of the probability of a railway incident occurring. In light of further considerations, it should be emphasized that the train driver is also a factor influencing active safety, particularly his or her predispositions for performing the function—above all, the psychophysical condition as well as skills and qualifications. Passive safety is a set of features of railway vehicles that affect the mitigation of the consequences of railway incidents from the perspective of their participants, examples being the reduction of braking delay, lowering the risk of derailment, and maintaining survival space. Passive safety often complements active safety, especially when all other measures have failed.

Leadership as a Key Determinant in Shaping Safety Culture and Managing the Human Factor

Organizations tasked with achieving success (which is essentially every organization) should be managed by a qualified managerial team possessing not only hard skills but also soft skills. It is the responsibility of management to effectively and efficiently utilize the organization's resources, achieve the organization's goals, and support the development of its individual members. In this perspective, managerial leadership emerges as a key factor in not only shaping the organizational culture but also as an essential aspect of a culture of fair treatment—a gateway to implementing the principles of a safety culture in which scapegoating is not an appropriate strategy.

Top management must demonstrate the appropriate leadership and commitment necessary for the development, implementation, maintenance, and continuous improvement of the safety management system by:

a) Assuming overall accountability and responsibility for safety;
b) Ensuring the commitment to safety from management at various levels within the organization through its actions and in its relations with employees and contractors;
c) Ensuring that safety policies and safety objectives are established, and that these policies and objectives are understood and aligned with the organization's strategic direction;
d) Ensuring the integration of the requirements for the safety management system with the organization's business processes;
e) Ensuring the availability of the resources necessary for the safety management system;
f) Ensuring the effectiveness of the safety management system in controlling the safety risks generated by the organization;
g) Encouraging employees to support actions that ensure compliance with the requirements of the safety management system;

h) Promoting the continuous improvement of the safety management system;
i) Ensuring that safety is taken into account when identifying the organization's business risks and managing those risks, as well as clarifying how conflicts between safety and business objectives will be identified and resolved;
j) Promoting a positive safety culture [9].

The above indicates that managers of railway enterprises should be responsible, capable of assuming individual accountability for decision-making processes, and competent in meeting their set objectives while generating high operational efficiency and ensuring the effective functioning of safety management systems. In line with the guidelines from the manual on aspects of improving the safety management system, it should be noted, among other things, that directors and managerial staff should foster discussions regarding significant risks that require management in order to ensure a shared understanding and awareness. Moreover, throughout the entire life cycle of the system, emphasis is placed on addressing significant risks. Top management must ensure that both its members and employees in positions that influence safety are aware of the significance, importance, and consequences of their actions, as well as how these actions contribute to the proper application and effectiveness of the safety management system—including the achievement of safety objectives. This awareness involves enhancing employees' knowledge of the organization's safety policies, understanding how they contribute to ensuring safety, and being informed about potential hazards and risks.

According to the previously mentioned guide *Requirements for the Safety Management System in the Area of Safety Certification or Safety Authorization*, published by the European Union Agency for Railways, safety culture is a set of philosophies, patterns, and behaviors that largely involve everyone—from the operational staff to those responsible for managing the company. Because it is a continuous process, safety culture is constantly shaped by the interactions between entities within the organization, which must adapt to its environment and ensure the integration of all its members [8].

In constructing a safety culture, we rely on models. One of the key and fundamental models is the scheme developed by Hudson (named after him). It presents, in a linear fashion, the evolution of the construction and development of safety culture—from a pathological state to a comprehensive one, with intermediate stages in the form of a reactive, refined, and proactive culture. The Hudson model, as considered in the context of organizational management, is particularly significant because it illustrates the processes of organizational culture development in connection with growth—a factor that takes on special importance within safety management. It should also be emphasized that the model path from a pathological culture, based primarily on punishment (both soft and hard penalties), to a comprehensive culture associated with a positive organizational climate requires a systemic approach that encompasses a range of improvement and support activities aimed at enhancing the organization's maturity in the area of safety culture.

One of the important methods that play a significant role in shaping a safety culture—especially in the area of eliminating human and organizational errors—has long been known as the so-called *Dirty Dozen* (translated as "Parszywa Dwunastka"). Although originally developed for aviation, it largely meets the needs of the safety culture in railway transport:

1. **Lack of communication** – errors and disruptions in the flow of information.
2. **Routine** – the certainty derived from long-term practice combined with a loss of awareness of existing hazards, often caused by repetitive tasks and monotonous work;
3. **Lack of knowledge** – a lack of clarity or certainty in understanding something;
4. **Distraction** – caused, for example, by diverted attention, confusion, or mental chaos;

5. **Lack of teamwork** – an inconsistent group effort caused, for example, by a lack of a sense of shared purpose, fear of reporting others' mistakes to management, an inappropriate leadership style, or poor communication;
6. **Fatigue** – often ignored because, unless it becomes excessive, one may not be aware of it;
7. **Lack of resources** – a shortage of tools, materials, outdated documentation, or unsuitable working conditions;
8. **Pressure** – caused by the demands of superiors or coworkers, a lack of time, or improper task allocation;
9. **Lack of assertiveness** – the inability to refuse a task, which may stem, for example, from a lack of self-confidence, fear, or personal insecurities;
10. **Stress** – agitation caused, for example, by time pressure, a new methodology, changes in task scope, rivalry, or personal factors;
11. **Carelessness** – an erroneous assessment of the possible consequences of an action, caused, for example, by pressure, a lack of experience, or insufficient knowledge;
12. **Shortcuts** – deviations from standard procedures accepted by most people as ways to simplify work [3].

In railway transport, increasing attention is being paid to the principles of the Just Culture concept, which is based on the experiences of other sectors where safety plays a crucial role—such as healthcare or aviation. This reflects the ongoing globalization characterized by the uniformity of attitudes, tendencies, and behaviors. The phenomenon underlying Just Culture, that is, a culture of fair treatment, is still relatively new in both the academic and practical environments in our country, although never before has the importance of Just Culture been so strongly emphasized and the dissemination of knowledge about it so widely pursued—especially in areas where the safety of the service and the user is of crucial importance.

One of the organizational approaches was to search for errors and identify the responsible person, followed by individual punishment. This punitive approach does not solve the problem. People function within a system designed by the organization. Individually, an employee might be at fault, but often the system is also operating incorrectly. Punishing individuals without changing the system only reinforces the problem rather than solving it.

This concept has an interdisciplinary character, which accounts for its great popularity. Moreover, due to its key attributes, it can be used both for safety management and for shaping a safety culture in railway transport in terms of efficiency. An honest and fair culture is one that learns and improves through the open identification and examination of its own weaknesses. Organizations with such a fair culture willingly reveal areas of weakness because they intend to address them for improvement. It is crucial that employees feel supported and safe when reporting any irregularities or concerns.

An important assumption of the concept outlined above is building a mutual balance between safety and responsibility. Achieving a fair culture (in accordance with Aristotle's principle of the golden mean) through any given program is based on the conviction that fairness and learning can result from the relationship between employees' actions and management's responses to those actions.

The Safety Management System as an Integrator of Risk Management Processes and the Investigation and Analysis of Railway Incidents

The safety management system within an organization, although extremely important for the final outcome, often goes unnoticed by stakeholders because it is integrated into the organization's operational processes. When defining the safety management system for the railway industry, it should be emphasized that it refers to the organization, means, and

procedures adopted by the infrastructure manager or railway enterprise to ensure the safe management of its operations [4]. The safety management system can be based on the concept of four pillars:

a) Safety policy and safety culture;
b) Safety risk management;
c) Safety assurance;
d) Safety promotion [1].

As part of the further development of railways within the framework of the Fourth Railway Package, the key pillars of the safety management system concept in railway transport have been defined. These pillars include:

a) the need to develop the assumptions for the safety policy and safety culture;
b) risk management through system analysis for the identification of hazards;
c) safety assurance through the implementation of a performance measurement system, change management, and continuous improvement of processes;
d) safety promotion appropriate to the needs and requirements.

According to Directive (EU) 2016/798 of the European Parliament and of the Council, the level of railway safety should, in principle, be maintained at an appropriate level—that is, in compliance with legal and technical standards—and, whenever possible, improvement measures should be introduced taking into account technological and scientific progress as well as the development of national and international law. In the process of raising the level of safety, it also seems necessary to consider human and organizational factors. At the same time, every entity operating within the railway system is responsible toward other parties for transmitting information relevant to safety by exchanging data, for example, regarding the suitability of railway vehicles for operation.

Article 17a of the Railway Transport Act states explicitly that railway carriers and infrastructure managers shall create safety management systems to ensure that the railway system is capable of meeting the Common Safety Targets (CST) by complying with national safety requirements, the safety requirements established in the Technical Specifications for Interoperability (TSI), while simultaneously applying common safety assessment methods (CSM). Meanwhile, infrastructure managers and railway carriers shall create safety management systems so that these systems:

a) meet specified requirements tailored to the nature, size, and other conditions of the activities carried out;
b) provide oversight of the risks associated with the introduction of new technical and technological solutions, including the risk from subcontractors, suppliers, materials, and services related to maintenance;
c) take into account social risk as well as the risk arising from the activities of third parties [12].

There are many typologies and classifications of risks within an organization, and it is important that areas with identified hazards and potential risk undergo in-depth analysis and more frequent monitoring than areas of lesser significance. In light of the above considerations, the area of technical risk—which is directly related to the safety of systems—deserves particular emphasis. Technical risk refers to the frequency of accidents and incidents leading to damage (caused by a hazard) as well as the degree of severity of that damage [10]. Technical risk is a combination of the expected frequency of losses and the expected severity of those losses. Risk may also be residual—that is, the risk that remains after the implementation of risk control measures [7]. A systematic approach is required through the implementation of the stages of risk management: analysis of all processes related to the activity, identification of hazards, determination and valuation of risk, implementation of

appropriate control measures, and verification of the effectiveness of the control measures and preventive actions taken.

Closely related to the proper risk management process in railway transport is the handling of railway events and potentially dangerous situations. Meticulous adherence to the requirements of safety management systems, along with thorough risk analysis in railway transport, neutralizes the risk of undesirable railway events occurring within the railway system.

In accordance with the regulatory provisions of the Railway Transport Act, we define the following railway events:

1. **Serious accident** – any accident caused by a collision, derailment, or any other event that has an obvious impact on the regulation of railway safety or on safety management:
   a) involving at least one fatality or at least 5 seriously injured persons, or
   b) resulting in significant destruction of a railway vehicle, railway infrastructure, or the environment, which can be immediately estimated by the accident investigation committee at an amount of at least 2 million euros.
2. **Accident** – an unintended sudden event or a series of such events involving a railway vehicle that results in negative consequences for human health, property, or the environment; accidents include, in particular:
   a. collisions,
   b. derailments,
   c. incidents at level crossings,
   d. incidents involving persons caused by a railway vehicle in motion,
   e. fire on a railway vehicle.
3. **Incident** – any event, other than an accident or a serious accident, that affects the safety of railway operations.

Regardless of the above classification, PKP Polskie Linie Kolejowe S.A., as the infrastructure manager, has introduced an additional classification of operational events (potentially dangerous situations) understood as an operational situation or railway event that is not a serious accident, accident, or incident, which causes a slight increase in risk—to a controlled level not exceeding the acceptable risk level.

The conducted system analysis should unambiguously and without objection assure all interested parties that railway events are not only monitored but that various cause-effect decisions are also made regarding them. Hence, it seems essential to appropriately define the root causes associated with railway events. Undoubtedly, the interconnections between the operator and the technical asset or work environment shape both the positive and negative outcomes of tasks resulting from railway operations. In this regard, it should be assumed that the operator (i.e., the human factor) in this relationship is of strategically, indeed fundamentally, significant importance. While the technical system can be controlled, the human factor—being complex in nature—is not only difficult to regulate through control mechanisms but also determines the strengths and weaknesses of the railway system. Unfortunately, most of the root causes of railway events result from human error. Even the best program is incapable of eliminating human error; at best, it can reduce the probability of its occurrence. Therefore, the key question becomes how to effectively manage the safety of railway transport by analyzing the behaviors within the dynamic system of railway operators, which can include, among others, train drivers (on the side of the railway carrier) and railway traffic controllers (on the side of the infrastructure manager).

SPAD-type Events

A particular type of event is one that is strictly related to active safety, defined by the term SPAD (from English: *signal passed at danger*). Using the concept of SPAD, we can describe a whole range of events associated with a train failing to stop at a signal indicating "Stop" or at a designated stopping point. The above situations are classified as events in categories B04 and C44, while potentially dangerous situations fall under category D-79. An event is classified as D79 if it was still possible for passengers to board and alight from the platform without the need for the train to reverse.

Events classified as SPAD also include (and this is particularly important) occurrences under varied circumstances. Many causes of such events can be identified, among which the following are paramount:

a) Omission of the W4 indicator, which denotes the stopping point for the front of the train at a railway station or a passenger stop, consequently leading to the train departing the platform;
b) The failure of a railway vehicle to stop at a given station or passenger stop as scheduled, or improper handling of the vehicle;
c) Omission of the maneuvering disc that prohibits further movement, which may lead to the train splitting at a turnout;
d) Delayed initiation of braking by the train driver;
e) Adverse weather conditions, for example, frost or rain.

Other causes that are possible (or likely) to occur include, among others, the operation of a railway vehicle without the required permission, failure to exercise due caution, inadequate observation of the track ahead, incorrect reading of signal indications, improper cooperation between the train driver and the train manager, the driver's lack of response to maneuvering signals given immediately before the event, or failure to adjust the speed to local conditions.

The above-mentioned causes are defined as direct causes. The possibility of a SPAD event occurring may also be influenced by indirect causes, which include frequent timetable changes, errors or insufficient training of the train driver, as well as the driver's poor psychophysical condition, fatigue, stress, health problems, or personal issues. Directly affecting the train driver's concentration is also engaging in mobile phone conversations while operating railway vehicles.

SPAD Events – A Challenge for the Polish Railway System

The impact of SPAD events on the functioning of the railway system and its safety is evidenced by the railway incident statistics maintained by the President of the Office of Railway Transport, as well as the safety recommendations issued by the State Commission for the Investigation of Railway Accidents. Considering the period from 2018 to 2022, the national statistics are presented as in Table **1**.

Tab. 1. Overview of SPAD Events in the Years 2018–2022 [11]

year	accident category B04	incident cat. C44	potentially dangerous situation category D79
2018	35	86	19
2019	28	83	13
2020	14	86	20
2021	33	136	16
2022	34	118	29

Source: Own elaboration based on source data from the Office of Railway Transport

From the summary, we can draw the following conclusions:

- In the given period, no events qualified as serious accidents occurred;
- There is a growing trend in the occurrence of railway accidents;
- After 2020, there was a sharp increase in incidents in railway transport;
- A rising trend in the occurrence of potentially dangerous situations is observed.

Based on the data presented in the *Railway Transport Safety Report 2022* published by the Office of Railway Transport, we conclude that there is an upward trend in the SPAD events indicator, which is measured as the ratio of the number of SPAD events to operational work – in 2022, it reached a value of 0.5566.

Regardless of these data, media reports from 2023 are also not optimistic. In August 2023, within a 48-hour period, there were two events involving Koleje Mazowieckie and PKP Intercity, which consisted of failing to stop at a signal indicating "Stop". In the following 14 days, a collision occurred between a Koleje Mazowieckie train and a PKP Cargo locomotive due to the omission of a "Stop" signal. All these events took place in the Mazovian Voivodeship. Another event at Gdynia Główna station in October 2023 resulted in more serious consequences – after the collision of two "Polregio" trains, the injured had to be hospitalized.

Analyses conducted by the President of the Office of Railway Transport indicate that the most common cause of SPAD events has, for years, consistently been the train driver's loss of concentration. However, it is crucial to examine the reason for this loss of concentration, particularly whether it was related to the performance of the train driver's duties or if it represented a case of non-compliance with the applicable procedures. In the analyzed sample of 34 SPAD events, the causes of loss of concentration that can be classified in the first group were:

a. diagnostic messages regarding vehicle malfunctions (e.g., inverter shutdown, low inverter voltage);
b. potential irregularities in the railway infrastructure (e.g., fluctuations of the catenary system);
c. persons located near the railway track or approaching it.

The second group of causes of the train driver's loss of concentration is associated with violating applicable procedures, primarily due to using a mobile phone while driving—a problem that also affects road transport not only domestically but also on a broader global scale [6]. The President of the Office of Railway Transport has repeatedly emphasized that an appropriate training process for train drivers, as well as the implementation of technical solutions supporting the train driver's work during train operation, is a crucial process for preventing SPAD events.

Analysis of SPAD Events and the Corrective Plan at Szybka Kolej Miejska sp. z o.o.

Szybka Kolej Miejska sp. z o.o. is a certified railway carrier in which a safety management system and a Safety Culture Strategy have been established and implemented. This, among other things, indicates that the carrier, through the implementation of a risk management process, proactively conducts its operations based on established organizational culture principles, as well as with the involvement of top management in achieving safety-related goals. Operating based on a safety culture model, however, requires wide-ranging actions based on a systemic approach so that the results achieved are oriented toward the so-called "zero accidents" concept. The safety culture at Szybka Kolej Miejska is one in which safety plays a very important role. Because safety is such a complex phenomenon, it is not enough simply to "add and be safe." The characteristics of safety culture and the perspective on different types of culture can be seen as indicators of progress in the organization's development.

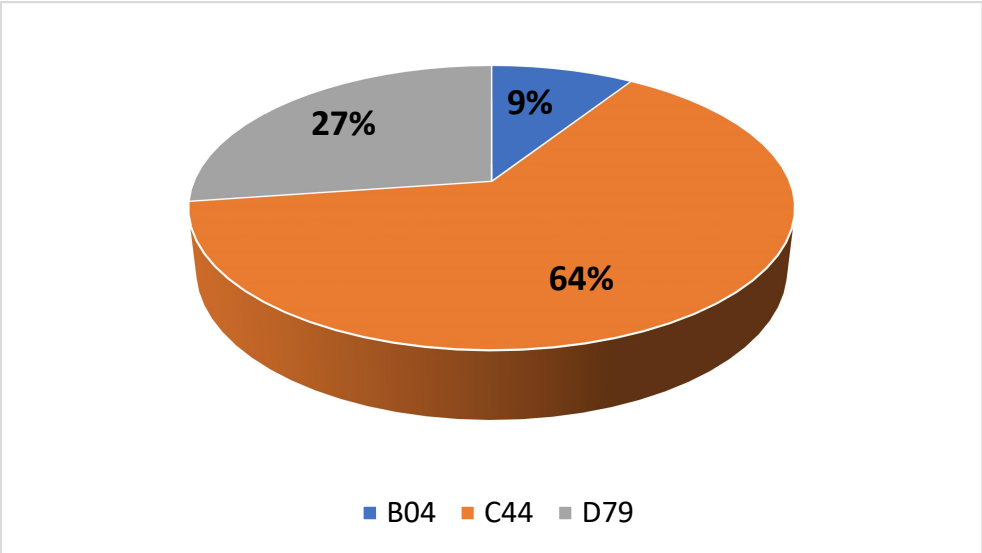
Train drivers are one of the key professional groups from the perspective of railway traffic safety; therefore, comprehensive actions are needed with the overriding goal of increasing the level of safety. In order to effectively minimize the occurrence of SPAD events, Szybka Kolej Miejska sp. z o.o. has undertaken a series of initiatives. The company has developed safety and maintenance management system documents, such as:

- the Train Driver's Instruction;
- the Instruction on Handling Serious Accidents, Accidents, Railway Incidents, and Operational Difficulties;
- the Post-Event Procedure; and
- the Crisis Management Plan of Szybka Kolej Miejska sp. z o.o.

These documents describe the measures and procedures related to working at the train driver's position, as well as the procedures to be followed in the event of an incident—including the rules for reporting an incident or operational difficulty and the corrective and preventive measures to be taken. The company also prepared informational bulletins in response to the occurrence of an event and formulated corrective and preventive actions. Particularly important for counteracting SPAD events were actions involving proper training and assessment of train driver competencies. SPAD situations were discussed during periodic briefings for train drivers and train managers. For train drivers involved in an event, consultations were held on the operation of the train's braking system, knowledge of railway regulations, and familiarity with the procedures of the safety and maintenance management system. Other remedial measures employed by the company include instructional rides with train driver instructors, training on a railway vehicle simulator, and conducting knowledge and skills tests. The company's initiatives also included mentorship for individuals with limited professional experience.

These preventive actions, focused on the human factor and the train driver's position, did not contribute to achieving the expected level of safety or eliminating SPAD events, as evidenced by the company's maintained hazard register.

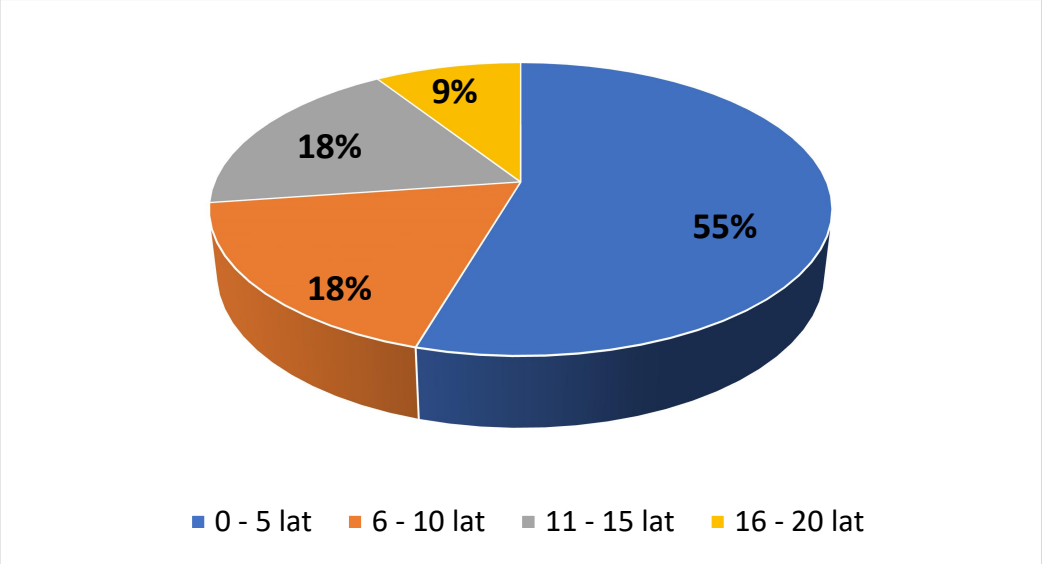
Analyzing the cases of SPAD events that occurred at Szybka Kolej Miejska sp. z o.o., one can observe a trend of increasing numbers of events, particularly those classified as incidents in railway transport. Chart No. **1** presents the share of the various categories of SPAD events in 2023.



1. SPAD events by category

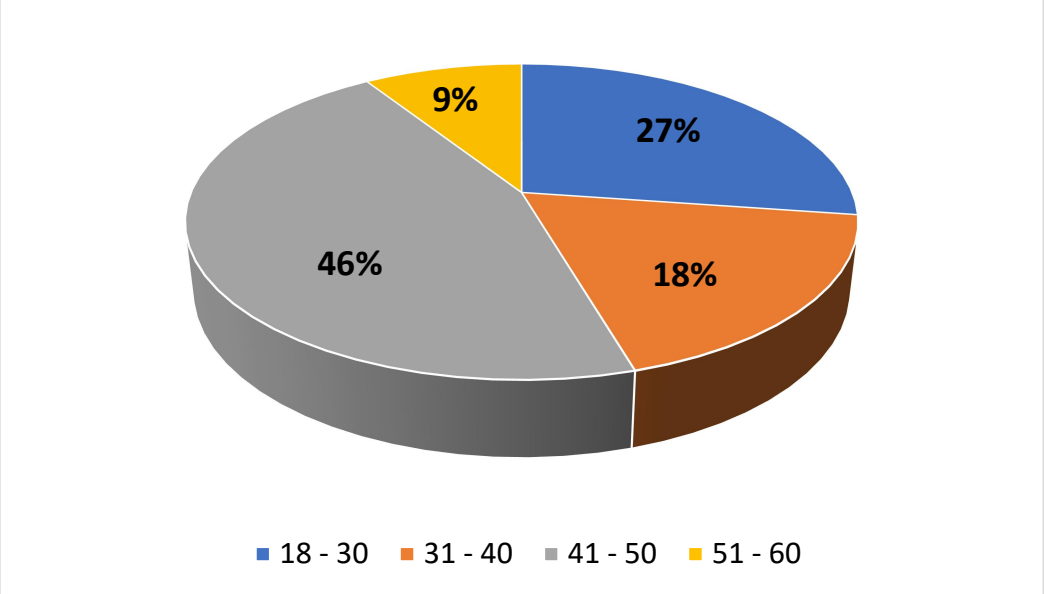
At the same time, it should be emphasized that SPAD-type events in 2023 constituted 17% of all events registered involving the Company's railway vehicles. In most cases, the situations occurred during the initial hours of the train driver's shift. No vehicle operator was under the influence of narcotic substances or alcohol. The employees possessed valid medical examinations. The required rest hours during the performance of professional duties were also observed.

Examining individual cases and the circumstances of the event, it is difficult to clearly indicate a trend in the concentration of factors contributing to these events. An analysis of the professional experience of the train drivers involved in the events in 2023 shows that 55% of the drivers had less than 5 years of work experience (Chart **2**).



2. Seniority of drivers involved in SPAD incidents in 2023

At the same time, taking into account the age structure of drivers involved in the incident, we can state that people over 40 years of age predominate (Figure **3**).



3. Age of drivers involved in SPAD incidents in 2023

Due to the difficulties in determining causes other than the human factor that contributed to the occurrence of SPAD events, the Company's Management proactively initiated additional actions within a corrective plan aimed at examining the auxiliary processes and support functions of the transport process in greater detail and identifying critical areas requiring improvement. In connection with the above, in addition to the actions taken under the safety management system, the Company appointed a SPAD Prevention Coordinator, who actively provided support in identifying further areas needing improvement. The Management's actions to prevent SPAD events as specified in the corrective plan (Table **2**).

Tab. 2. Corrective Plan for Preventing SPAD Events

Actions	Description of Actions
Increased supervision of drivers' work discipline.	Carrying out ad hoc inspections of the "order at the driver's station" in various locations and times. The inspections should be remote and stationary.
Implementation of notifications reminding about the provisions of instructions/procedures.	Organizational units employing drivers and train managers after each case of irregularities or incidents (systemic - preventive action).
Development and implementation of detailed safety rules during the passage of people (as well as the train manager) in the driver's cabin.	Establishing driving rules with employees trained for the driver's position - e.g. repeating signals, continuous observation of the route.
Building crew awareness of distraction from conversation or watching films while driving.	The train manager should react every time he finds that the driver is, for example, watching a film on a mobile device while driving or listening to loud music.
Developing mandatory questions for the most frequently occurring events.	A representative of the unit responsible for safety and another designated employee, and if necessary, also a consultation with a psychologist.
Developing mandatory questions for the most frequently occurring events.	The sets of questions should include issues related to the driver's activity during work, e.g. did you use mobile devices in any way while driving train no. "1234"? Was anyone in the driver's cabin before and at the time of the incident?
Analyses of future application of other than current service consequences.	Analysis of the possibilities of employing employees in other positions not related to safety, e.g. delegating to another work position for a period of up to 3 months.
Conducting tests, knowledge and skills tests after the event, extraordinary simulator training.	Introduction of additional training and verification of the driver's susceptibility in the position. After the end of each ride on the simulator, a comprehensive analysis of the results should be prepared, which is a source document in the professional development process.

Actions	Description of Actions
In the event of a SPAD event, each driver involved in the event is required to hold individual consultations with a psychologist on behalf of SKM.	The purpose of the consultation is to examine possible emotional effects and assess the driver's ability to continue working in the position. The consultations should be carried out immediately after the SPAD incident and take place in parallel with the work of the railway commission.
Developing a message for passengers after SPAD-type incidents.	Appropriate placement of the message within the available communicators
Paying attention to whether monitoring cameras, e.g. in the driver's cabin or front ones, are not covered/damaged.	In the event of noticing that the camera is covered before the start of the work shift, the driver should be obliged to immediately restore it to the required condition, report the fact that the camera is covered to the superior, and in the event of difficulties in dismantling, e.g. tape, copy the appropriate notification via the ICT system in order to eliminate the difficulties by the unit responsible for maintaining the rolling stock.
Conducting training for members of the railway commission.	The training includes a reminder of the most important issues related to the conducted proceedings and proposed preventive measures.
Increasing the number of training rides.	Introduction of the obligation to conduct additional training rides for drivers who have participated in a SPAD-type incident in the last two years.
Repeated reminders of internal regulations by the superiors of the train crews to their subordinate employees.	Systemic generation of notifications, including, among others, the ban on using private multimedia devices while performing official duties related to the management and safety of rail traffic.
Considering the possibility of installing video cameras directed at the driver's workstation.	Modernization of the video monitoring system in order to observe the driver's activities at the workstation while driving a train.
Introducing an item related to the skills of self-assessment of psychophysical condition to the training program for drivers.	Rebuilding the topics of periodic training in a way that strengthens issues related to the human factor, “soft” skills, coping with stress and proper self-assessment of one’s mental and physical condition.

Own elaboration: SKM source materials

At the same time, the SPAD Events Coordinator, in cooperation with the Board Representative for the Safety Management System and Maintenance, has undertaken a series of initiatives aimed at improving the training and supervision process within the organization.

Actions for the Prevention of SPAD Events within the Competence of the SPAD Events Coordinator (Table **3**).

Tab. 3. SPAD Event Prevention Plan within the Competence of the SPAD Events Coordinator

Actions	Description of actions
The legal status regarding conducting checks for the presence of psychoactive substances on employees and sending drivers who contributed to the occurrence of an incident for tests was verified.	The possibility of sending for extraordinary tests after SPAD events to the Railway Occupational Medicine in order to check the psychophysical condition of drivers has been confirmed. Tests for the presence of psychoactive substances and other intoxicants have been carried out.
As part of the conclusions from the SPAD events, additional train markings were implemented in the work plan.	The work schedule of train crews has been marked (with a coloured marking and description in the legend) for trains that have a change of train type on the route (commercial/business). At the same time, the planning department on flat circuit charts, in order to optimally build work plans, has also implemented an action consisting in distinguishing the trains in question.
As part of the conclusions from the SPAD events, a letter was sent to the Infrastructure Manager PKP PLK S.A. regarding a reminder of the rules for train dispatchers.	These principles described in the regulations formulated that in the case of accepting and dispatching from a station a train that has a scheduled stop there, they should strictly comply with the provisions of Instruction Ir-1, § 42, paragraph 9, which reads: "For a train that has a scheduled stop at a station, the permissive signal on the departure semaphore should be given only after the train has stopped. If necessary, an earlier command to set a permitting signal on the departure signal or to set this signal before the train stops may be permitted by technical regulations.”
Actions have been initiated in connection with identified risks related to the implementation of the new 2023/2024 timetable from 10 December 2023.	These activities included various activities related to preparing the transport process, including preparing a list of information on planned changes in SKM train operations (divided into lines S1, S2) in RRJ 2023/2024 with particular emphasis on ongoing investments in the PKP PLK network, e.g. reconstruction of the Warszawa Zachodnia station or resumption of train operations on line no. 7 on the Warszawa Wschodnia - Warszawa Wawer route (and launching a new Warszawa

Actions	Description of actions
	Grochów stop). Additionally, arrangements were made with PKP PLK S.A. regarding the date of making the renovated infrastructure available on the Warszawa Wschodnia - Warszawa Wawer route in order to familiarize drivers with the route - it was considered reasonable to allow the implementation of route familiarization for at least two weeks preceding the start of commercial train operations.
In connection with one of the railway incidents during shunting work, the driver department sent a reminder notification to drivers regarding shunting work techniques.	The reminder notification included in particular information on the obligation to observe signals and indicators and to comply with their indications, to observe the correct setting of switches, derailers, turntables, transfer machines, etc., to make sure that there are no obstacles to travel on the route and to refuse to carry out an order if the shunting work plan was not discussed, the signal or orders were issued in a manner inconsistent with the regulations or in a manner that raises doubts, and the execution of the shunting movement should be carried out if it does not endanger the safety of traffic and people.
Improvement actions have been taken in the process of recruiting drivers/candidates for driver certificate training.	A rule was introduced regarding the participation of an instructor in the recruitment process of a train driver and a pilot process of conducting interviews with train drivers who are in the period of notice of termination of their employment contract, the so-called "Exit Interview", was implemented in order to obtain information that could potentially affect safety.
An order was issued for the drivers of instructors to immediately conduct extraordinary interviews with drivers.	The interviews included information on: recent SPAD events together with an indication of the reasons, e.g. distraction of the driver's attention; a ban on using multimedia devices (including telephones) while the train is running; the need to verify the place and time of the next planned stop and its nature (commercial stop/technical stop). Train instructors were informed about the need to anonymously record the articulated significant reservations of train drivers regarding work organization and then provide feedback to the Coordinator. After the interviews, a summary of the reports received from train drivers was

Actions	Description of actions
	prepared, which enabled their analysis and implementation of corrective actions in the scope of work plans and short transitions between serviced trains at turnaround stations.
Including activities in the scope of training on a driving simulator in the Safety Improvement Program for 2024 in the scope of minimizing the risk of SPAD-type events.	The activities include, among others: ad hoc simulator training for drivers for whom violations were found related to failure to comply with the ban on using mobile devices while driving, the passage of unauthorized persons in the cabin, or failure to comply with safety rules while driving a train - even if in a given situation there was no railway incident; ad hoc personal inspections/monitoring in terms of order at the driver's station and compliance with safety rules while driving a train; working time control, periodic instructions, replacement rides.
Changing the training system in the Periodic Instruction Program, including the inclusion of the subject of SPAD events as a separate issue.	Supplementation of the instruction program for drivers and train managers in order to directly take into account issues related to minimizing the risk of SPAD-type events and to ensure consistency and a systematic approach to the activities carried out.
Analyzing reports from training rides conducted by instructor drivers in 2023.	As a result of the analysis, changes were initiated in internal regulations in order to determine, among others, the optimal instructional driving program, the method of flow of information on driving results, and the introduction of improvement activities in the work of the instructor driver. In 2024, the number of instructional rides will increase along with the improvement of the quality level.
Introducing a rotational assignment of drivers to instructor drivers.	The training department, as part of the optimization and improvement of training/supervision processes, will swap instructor drivers for individual groups of drivers in such a way that each instructor driver in 2024 will be assigned a different group of employees than in 2023.
Analyzing the performed inspections in the scope of drivers' work, together with the identified irregularities, conclusions and recommendations, if they occurred in a given protocol.	In addition, verification was made of what issues are covered by inspections in the scope of drivers' work and whether additional supervisory activities were carried out in the case of employees who were reinstated to work as drivers after being removed from work as a result of

Actions	Description of actions
	contributing to the occurrence of a SPAD-type event and whether work discipline was verified during the inspections in terms of the correct implementation of "swap" type trips aimed at ensuring planned breaks for crews (in work shifts with a large number of trains).

Own elaboration based on SKM source materials

Regardless of the aforementioned actions, further areas that require safety improvements continue to be identified. As a prelude to the conclusion, it can be noted that, whatever may be said about the matter, the "railway" has never stood still.

Conclusion

Everyone—without exception (both railway employees and passengers)—must realize that safety is not only a legal requirement but also a key and essential condition for the sustainable development of the railway industry. Therefore, every entity operating in the railway sector should maintain and enhance the level of safety in its activities. Adopting a proactive approach to safety issues is a cornerstone of safety culture. This approach is primarily based on effective risk management, including the use of knowledge and competencies to identify hazards and implement appropriate risk control measures.

Given the nature and type of operations of individual railway entities in an extremely competitive market environment, and considering the fact that resources are limited, implementing an appropriate management system will enable the optimal allocation of resources to the areas identified in the process of continuous improvement. The result of a properly implemented and executed process will not only be an improvement in the level of safety but also a reduction in costs associated with the late detection of non-compliance, and in extreme cases, with railway accidents or incidents. An important aspect of implementing a safety culture is the involvement of public institutions, academic units, industry media, and other entities connected with the broadly understood railway sector, which, by fulfilling their tasks, will support the development of a safety culture.

The safety of the railway system requires that as many situations as possible—which have or may have an impact on railway safety, including accidents, incidents, potentially accident-prone events, and other dangerous occurrences—be reported voluntarily and without delay. The collected information should be used for risk management, particularly for the identification of hazards. Ultimately, it should serve to develop proactive safety management.

The engagement of management is crucial in creating and enhancing safety management systems and in developing a safety culture. Management should play an active role in communicating safety principles. Furthermore, management should be actively involved in the process of disseminating information. It is precisely through management’s commitment to improving processes that one can manage not only the safety of the organization but also the organization itself in a complementary manner. Such a proactive rather than reactive approach significantly contributes to minimizing the risk of railway incidents, including SPAD events. A proactive stance allows for the early implementation of preventive measures, thereby avoiding the catastrophic consequences of events that could lead to injuries or fatalities among passengers and employees. It is impossible to manage an organization responsibly without an appropriate and proactive approach from top management.

Source materials

[1] Bugalia N., Maemura Y., Ozawa K., Safety Culture in High-Speed Railways and the Importance of top management decisions, Asian Development Bank Institute, Tokyo
[2] Czajkowski W., Wąs-Gubała J., Bezpieczeństwo personalne w perspektywie kulturowej, „Studia nad bezpieczeństwem", 2, 2017
[3] Dąbrowska J., Czynnik ludzki w lotnictwie, Prace Instytutu Lotnictwa, 12 (221), 2011
[4] Dyrektywa Parlamentu Europejskiego i Rady (UE) 2016/798 z dnia 11 maja 2016 r. w sprawie bezpieczeństwa kolei (Dz.U. L 138 z 26.5.2016)
[5] Jabłoński A., Jabłoński M., Mechanizmy kształtowania kultury bezpieczeństwa w transporcie kolejowym, wyd. CeDeWu sp. z o.o., Warszawa 2020
[6] *Maszynista w centrum uwagi,* https://utk.gov.pl/pl/aktualnosci/18330,Maszynista-w-centrum-uwagi.html
[7] PN-EN 50126-2:2018-02, Zastosowania kolejowe -- Specyfikowanie i wykazywanie niezawodności, dostępności, podatności utrzymaniowej i bezpieczeństwa (RAMS) -- Część 2: Sposoby podejścia do bezpieczeństwa, PKN, Warszawa 2018
[8] Przewodnik – Wymogi dotyczące systemu zarządzania bezpieczeństwem w zakresie certyfikacji bezpieczeństwa lub autoryzacji bezpieczeństwa, European Union Agency For Railways, Vallencieness 2018
[9] Rozporządzenie delegowane Komisji (UE) 2018/762 z dnia 8 marca 2018 r. ustanawiające wspólne metody oceny bezpieczeństwa w odniesieniu do wymogów dotyczących systemu zarządzania bezpieczeństwem na podstawie dyrektywy parlamentu europejskiego i rady (UE) 2016/798 oraz uchylające rozporządzenia komisji (UE) nr 1158/2010 i (UE) nr 1169/2010
[10] Rozporządzenie wykonawcze Komisji (UE) nr 402/2013 z dnia 30 kwietnia 2013 r. w sprawie wspólnej metody oceny bezpieczeństwa w zakresie wyceny i oceny ryzyka i uchylające rozporządzenie (WE) nr 352/2009
[11] *Sprawozdania ze stanu bezpieczeństwa ruchu kolejowego,* https://utk.gov.pl/pl/dokumenty-i-formularze/opracowania-urzedu-tran/20397,Sprawozdania-ze-stanu-bezpieczenstwa-ruchu-kolejowego-2022.html
[12] Ustawa o z dnia 28 marca 2003 r. transporcie kolejowym (Dz.U. 2023, poz. 1786)