Intelligent Wagon: A New Approach to Monitoring the Wagon's Technical Conditions

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Abstract. Information generating on rail freight wagon components that carry a higher risk of damage during operation would create ideal conditions in real time and improve the safety control of their operations. Appropriate application technology can provide a solution for improving the quality of railway wagon operation. The aim of presented paper is to measure, monitor and signal the vehicle during the operation of the vehicle used RFID technology in theoretical and after testing in real conditions of rail freight wagon.

Keywords: Wagon · Monitoring · RFID

1 Introduction

Railway safety policy is currently used by all rail freight transporters as well as passenger rail transport. It focuses on the security management system that the company continually maintains and improves. Safety considers the company as the basis for the success and satisfaction of its customers and employees. A secure, reliable and environmentally friendly rail freight service is being developed [1]. By constantly improving the parameters of the technical and technological equipment used by the company in the railway operation, it contributes to the elimination of possible risks and consequently to the reduction of the negative impacts on safety and the environment [2]. To enhance safety, the company also contributes to the implementation of uniform principles and common rules for Europe's integrated interoperable rail system (Fig. 1). Through the positive influence of employees and the built in employee education system, the company ensures the increase of health and safety at work of employees as well as their professional competence to perform the function [2, 3]. By consistently analyzing accident incidents and emergencies in the railway operation, the company continually creates the conditions for their prevention.

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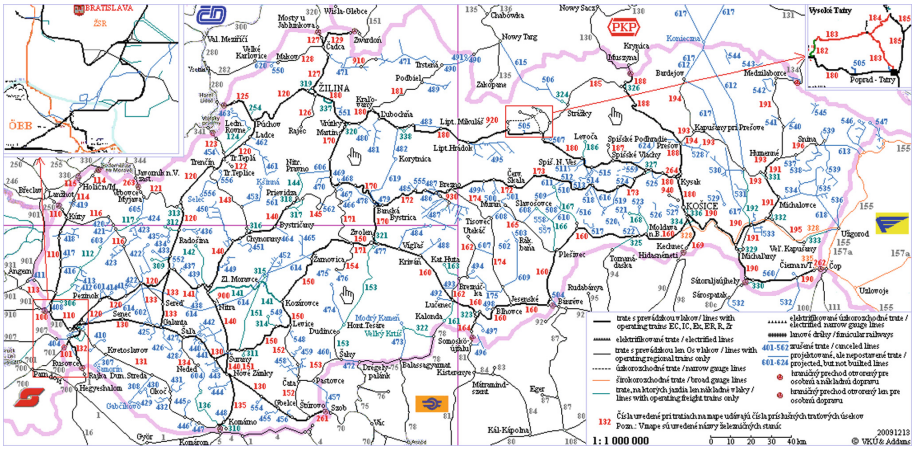

Fig. 1. Rail map of Slovakia [8].

well as their professional competence to perform the function [4]. By consistently analyzing accident incidents and emergencies in the railway operation, the company continually creates the conditions for their prevention [5].

1.1 State of the Art of Problematic

When we introduced railway safety and monitoring policy, it is necessary to focus on the risk management of rail crossings, particularly in areas where rail undertakings are required to reduce rail crossing risks where feasible. The efforts of railway companies should focus on those crossings identified or cited as the greatest common risk (risk for cross-border users and those potentially affected by the succession of risky events such as staff and trains), or that they pose a high risk to individual users [5, 6]. Wherever feasible, the infrastructure manager must endeavour to close or redirect crossings or increase their security by providing improved security features (e.g. LED lights, better reflective materials, surface and color treatment of road asphalt, adding lighting). An important aspect is to educate railroad users about how to correctly use the crossings (Fig. 2), safely navigate to the crossings, alert them to the possible risks and the danger of cross-border abuse [7].

On the other hand, it is necessary to cooperate with the police, transport and rail police and the components of the control and inspection of the railway companies, and to seek to promote law enforcement and prosecution of anyone who abuses railway crossings and take appropriate measures to help the police in their identification [7, 8]. As part of the regular inspections, it is necessary to correctly maintain the crossings of the infrastructures (including the control vegetation) in such a way that the safety incidents due to the infrastructure failure are minimized. This means that only eligible persons can work on railway crossings and their eligibility should be regularly evaluated/monitored [8]. Last but not least, support research on risk identification and its subsequent reduction on railway crossings. This is followed by the current practice of frequent accidents, failures and delays in rail transport caused by the poor technical

Fig. 2. Monitoring of technical conditions of wagons [9].

condition of wagons. The main cause is the poorly controlled technical condition of the wagons, unsystematic maintenance and low prevention, resulting from the non-existent evidence of technical and operational parameters of railway wagons (speed, distance traveled, loading or overloading of wagons, etc.) [9].

This condition is acute, and with worsening accidents and collisions on the railroad is even worse. As a result, there is a considerable amount of money spent on repairs and maintenance, such as the fleet, as well as the railway itself and the real estate (stations, trolleys, etc.). They are often accompanied by losses in human lives. Significant damage is also caused by the necessary limitation of traffic on the road due to its damage and subsequent, often long-term, difficult repairs. To address these shortcomings, solutions are in place, but they deal with the emergency but not the root cause. Tracking and timely planned fleet maintenance can lead to the prevention of the entry of problem means of transport into the transport route, thereby eliminating the risk situation to a minimum.

2 Technical Specifications of the Wagon's Monitoring

The essence of the technical solution consists in the installation of information technology (IT) elements on each operated railway wagon requesting entry to the transport route and using the IT elements (Fig. 3) located on it, to create conditions that all (preselected) will be monitored, recorded and evaluated operating parameters [6, 7]. On the basis of these monitored and continuously evaluated parameters, it will be possible to schedule maintenance, monitor the technical condition of the wagons, and also to signal the fault in real time. Real-time fault signaling will make it possible to restrict the operation of the damaged wagon, immediate withdrawal of seriously damaged railway wagons [9].

Fig. 3. Monitoring of wagon's technical conditions - management/monitoring center [9].

Such wagons will be subject to scheduled maintenance according to mileage, depending on the wear of the critical wagon hubs, respectively. Depending on the amount of material, but also to indicate unevenly loaded wagon load (or overloaded wagon). Subsequently, such a wagon will not be leaked into a traffic junction until the fault is removed. [9] The application of IT elements on a railway wagon will enable its unambiguous identification and transmission of operational parameters into the information system of railways, which will considerably simplify the operation of rail transport, statistical evidence, tracking the technical condition of railway wagons and the resulting maintenance planning.

2.1 The Way of Monitoring the Technical Conditions of the Wagon

The running of a railway wagon with an electronic control of the technical condition is comprised of a data center where all the information about the wagon's technical condition (Fig. 4), the position of its wagon and all operating parameters of the wagon is collected by means of the sensors, and also the identification numbers and wagon recognition characters. Using the speed sensor, it evaluates the parameters (wagon speed, mileage and rotation status of the respective bogie on the wagon). These data serve to track trouble-free operation, but at the same time allow you to plan individual types of repairs (on a rolling and general basis) based on mileage to predict accidents and collisions during operation [5]. The temperature sensor monitor evaluates the temperature of the critical node of the wagon and thus also its ability to operate and at the same time informs the driver and the railway service personnel of the need to intervene immediately and to prevent possible accidents and consequent damage in full

operation in the event of overheating of the monitored components. The pressure sensor monitors the reaction and the ability to operate the braking system [9]. Through the brake sensor (brake seal wear), it monitors the performance of the wagon from the point of view of its braking capability and at the same time signals to the technical staff the need for timely replacement [10].

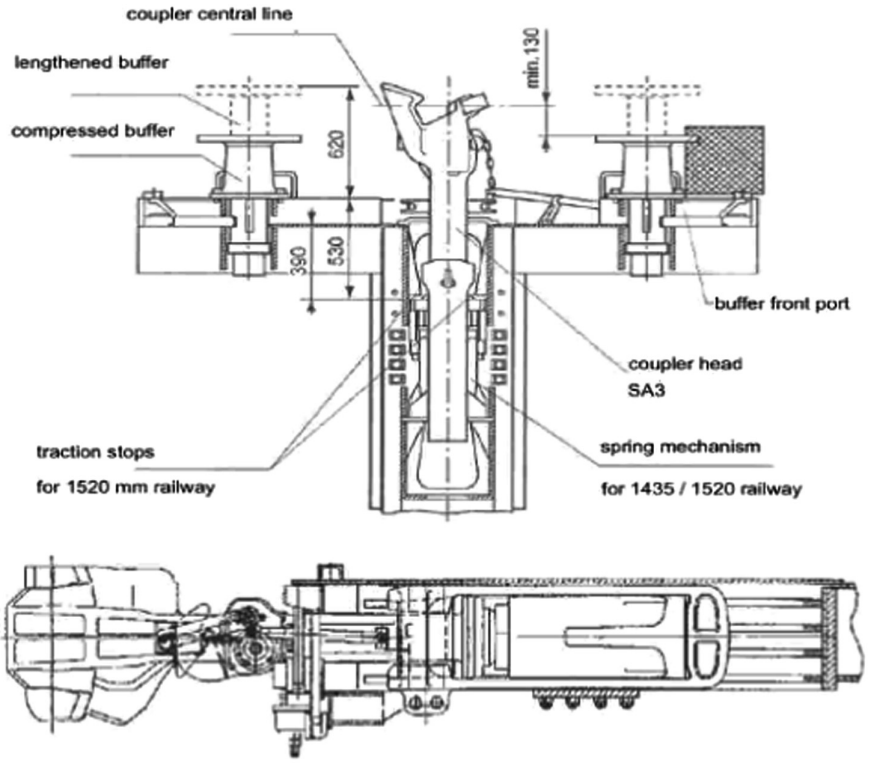

Fig. 4. Some examples of technical conditions monitoring (up - wagon's bumper, below - wagon's coupling) [10].

The brake cylinder position sensor is monitored and evaluated for its position. In the case of a negative signal from one of the brake cylinders, will prevent the train from commuting until the fault has been rectified. The load weight sensor monitors, evaluates and signals the overloading of the wagon and the uniformity of load storage. Due to the insufficient attention given to fleet operations, frequent collisions occur in the operation of the railway fleet, accidents, which can prevent the systematic monitoring and recording of the technical condition of wagons [9, 10]. The solution is applicable to the all companies, esp. for companies operating by rail transport.

3 Conclusion

According to monitoring the technical conditions of the wagon, the brake cylinder position sensor is monitored and evaluated for its position. In the case of a negative signal from one of the brake cylinders, Will prevent the train from commuting until the fault has been rectified. The load weight sensor monitors, evaluates and signals the overloading of the wagon and the uniformity of load storage. Due to the insufficient attention given to fleet operations, frequent collisions occur in the operation of the railway fleet, Accidents, which can prevent the systematic monitoring and recording of the technical condition of wagons. The solution is applicable to all companies and companies operating rail transport. Generating information on railcar bogie elements that carry a higher risk of damage during operation would create ideal conditions in real time to improve the safety of their operations. Appropriate technology application can provide a solution for improving the quality of railway wagon operation. The essence of the solution is measurement, monitoring and signaling during vehicle operation via contactless technology. This implementation is of great importance in practical use, as the influence of the human factor acting in connection with the technical inspections of railway wagons is reduced. The identification of risk factors and their ex-post evaluation will provide information to reduce the extent of adverse events associated with the poor technical condition of freight wagons.

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