

Safety Performance Analysis of the Movement and Operation of Locomotives

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Abstract

To estimate the state of the locomotive facility and work, performed by the locomotives, a system of planned and calculated indicators is used. The state of traffic safety in a locomotive facility is estimated in most cases by comparing the absolute number of traffic incidents with previous periods. Accordingly to the existing system of traffic safety analysis, the volume of work performed in the locomotive facility is not taken into account. **The purpose** of the research is to determine the methodology for forming a certain dimensionless indicator (or group of indicators) that will reflect the overall level of safety in the locomotive facility, taking into account the volumes of work performed by locomotives. The authors suggest the usage of the relative indicators to estimate the state of traffic safety, factoring in the volumes of transportation. As a **method of research**, we chose the method of the main components as the appropriate mathematical apparatus, which allows analysing the proposed indicators, characterizing the performed work and the traffic safety state with the necessary degree of informativeness. **As a result**, the most informative indicators and the degree of their correlation with the general index of traffic safety state were determined. **Originality** of the study lies in the fact that the system of indicators for the traffic safety analysis was improved; the concept of the traffic safety state index and the method of its determination using the method of the main components were improved. **The practical value** of the work is that we propose to use the relative indicators for estimating the traffic safety, taking into account the volumes of transportation; the ranking of the proposed indicators accordingly to the degree of their impact on the overall level of traffic safety is performed.

KEY WORDS: *railway transport; traffic safety; locomotive; indicators of locomotives operation; method of main components; traffic safety index*

1. Introduction

Compliance with the safety in operation of vehicles is a prerequisite for the passengers and cargo transportation. Operation of all railway systems must comply with the conditions for safe transportations. On the railway transport, much attention is paid to the traffic safety state. This is explained by significance of railway transport for the economy of any country and its social function concerning passenger transportation.

Transport companies constantly conduct an analysis of train traffic safety to obtain data about the level of actual or predicted train traffic safety. The results of the analysis of traffic safety state are used to estimate the effectiveness of measures aimed at ensuring a given level of safety, for the rational distribution of resources allocated for the tasks solution of safe trains traffic, for certification of transport services and technical means of railway transport, to justify priorities in the distribution of resources and suchlike.

The analysis of the traffic safety state is performed continuously and is based on the analysis of statistical data, expert assessments, and the use of probabilistic methods. Undoubtedly, to achieve absolute safety of traffic - at which the probability and actual occurrence of incidents (accidents, catastrophes, injuries, destruction of rolling stock and objects of infrastructure) will be zero is impossible. The highest level of the traffic safety state, theoretically, can be achieved if transportation is stopped. There will be no operation of the railway, as a result the probability of occurrence of incidents is minimal. This approach is contrary to the target of railway transport, but reflects the imperfection of the system of indicators used for the analysis of the traffic safety state.

2. Analysis of the Traffic Safety State

Transport companies [1-4, 6, 18], when performing the analysis of the traffic safety state, use a comparative method of estimating the absolute values of indicators for certain calendar periods of time. Using this approach, the change in absolute indicators such as: the number of transport events, the number of victims and injured persons, the number of passes of prohibited signals and others are estimated. The application of such an approach does not take into account the volume of work performed, intensity of movement, etc., which leads to an incorrect comparison of the periods being analyzed.

The system of planned and calculated indicators is used to evaluate locomotive facility and work performed by locomotives. The well-known one is the distribution of indicators in the work of locomotive facility on quantitative (volumetric) and qualitative indicators. With the help of these indicators and a number of calculations, comparison and analysis in the efficiency of locomotive operation and the general state of the locomotive facility is carried out. [5].

and 2015.

The composition of each component includes the values of the quantities $x_1 \div x_{11}$ to some extent. Indicators x_3, x_4, x_6 have the greatest impact on the values of the first main component. Indicators x_9, x_{11}, x_2 has impact on the formation of the second component. Indicators x_1, x_6, x_8 has impact on the third; the fourth is impacted by x_9, x_6, x_{11} ones.

4. Conclusion

Based on the calculations it was established that the index of operational traffic safety in the locomotive facility is most impacted by the following indicators:

- the ratio of the number of transport events resulting from the passage of the prohibited signal to the number of transported goods (x_9 - 18% of impact);
- the ratio of the number of transport events resulting from improper actions of locomotive crews to the average number of employees engaged in the operational work in the locomotive facility, (x_{11} - 14,5% of impact),
- the ratio of the total number of transport events to the fleet of locomotives in operation (x_1 - 14.5% of impact)
- the ratio of the number of transport events that resulting from unsatisfactory depot repair to the number of employees engaged in maintenance work in the locomotive facility (x_6 - 13.5% of impact).

Thus from the point of view of the indicators informativeness is expedient to carry out the analysis of the traffic safety state using relative indicators and taking into account volumes of transportations.

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