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Analysis of the effectiveness of the regulatory act "Regulations on the Railway Transport Safety Management System"

The article is devoted to a study that is quite rare in the scientific and technical literature. It is about analysing the impact of the regulatory document "Regulations on the Railway Transport Safety Management System" on the population groups and enterprises of Ukraine and its effectiveness after its approval. These two analyses are carried out before and after the approval of regulatory documents by state authorities (ministries, the Cabinet of Ministers, etc.). The relevance of this Regulation is explained by the need to implement European-type regulations in the activities of Ukrainian railways. The implementation is in line with the EU-Ukraine Association Agreement. The peculiarity of the Regulation in comparison with the existing one is explained by the fact that it becomes mandatory not only for JSC "Ukrainian Railways", but also for enterprises that use railway rolling stock and railway infrastructure in their activities. It was found that the railway transport sector includes 1517 enterprises. Based on the analysis of the impact of the Regulation on the Railway Traffic Management System on the interests of citizens, the state and business entities, a conclusion was made on the most rational option for achieving the goal of improving the level of railway traffic safety. The Regulation was approved by the Ministry of Infrastructure in 2021.

Keywords: traffic safety, railway transport, analysis, assessment, management, regulation, risk

Introduction. The relevance of adopting a new Regulation on the Traffic Safety Management System (hereinafter - the Regulation on the SMS) in Ukraine is explained by two aspects: the seriousness of the consequences of traffic safety violations in transport and the need to develop regulatory documents in line with European analogues.

Violations of train safety requirements and shunting operations in railway transport pose a threat to the lives and health of Ukrainian citizens, as well as increase damage to property owned by both the state and business entities. JSC Ukrzaliznytsia annually compiles a report on the state of train safety, and this document describes the violations. In 2021, 869 transport accidents occurred on Ukrainian railways, in which 182 people died and 134 people were injured. Of these, there was one catastrophe (no casualties); 480 accidents, including (a) 316 accidents with people caused by rolling stock in motion (182 people died and 134 were injured); (b) 64 accidents involving railway vehicles - collisions, derailments, etc. (no casualties) and 388 incidents (no casualties).

Of particular concern is the state of traffic safety during shunting operations and on sidings - more than 80% of rolling stock derailments occurred during shunting operations, many derailments occurred on sidings, and business entities neglect to report accidents to the competent state authority. Therefore, the number of derailments on sidings is actually higher.

Any railway accident has potentially disastrous consequences for the economy and society: damage to Ukrzaliznytsia's infrastructure, fire of locomotives and wagons, formation of a cloud of combustion

products over tens of square kilometres around the scene, and damage to personnel and ordinary citizens.

At the same time, it should be noted that business entities have significantly increased the number of rolling stock that is used on public tracks, which directly affects traffic safety. For example, JSC Ukrzaliznytsia owns 83.5 thousand freight cars, while the five largest railway operators own approximately 33 thousand freight cars. Projects are also being implemented to increase railway speeds and allow private traction to run on public tracks. Particular attention is drawn to railway operators that own their own private traction, which inevitably affects the overall traffic and transportation safety in Ukraine.

Therefore, the issues of traffic safety management are currently relevant not only and not so much to JSC Ukrzaliznytsia, but also to railway transport companies: those that have rolling stock and infrastructure on their balance sheets, or use rolling stock to transport products, etc.

A consistent cause of most transport accidents is the human factor: inattention, carelessness, lack of knowledge and skills.

The Regulation on the RMS is designed to implement a train safety and shunting management system that will allow efficient planning and use of funds for rolling stock modernisation and personnel training. In particular, ongoing comprehensive risk analysis will allow funds to be allocated to areas that are beyond the critical risk limit (repairs or staff training). At the same time, the potential damage to business entities will be analysed, which will help prevent accidents more effectively. Implementation of the SMS will allow business entities to save costs for rolling stock repairs, compensation for environmental damage and lost cargo, improve the quality of services and be competitive in both the domestic and European markets.

Analysis of recent research and problem statement. The Regulation on the SMS establishes the obligation of the railway transport enterprise to implement a procedure for identifying hazards or threats, risk assessment, and risk management. This issue is described in the works of other researchers.

Paper [1] states that the existing methodology for assessing the level of safety in the railway transport of Ukraine does not reflect the real and adequate state of railway safety. According to the authors, the solution to this problem may be the development of a risk management system. The paper presents the a posteriori and a priori values of risk, which allow to characterise the actual safety - the real state of railway traffic safety for the period under study, and the predicted railway traffic safety. However, the risk system proposed in this paper is of a generalised nature, where the analysed risks are combined into the following groups: general, local, technological and technical risks, which makes it difficult to determine the causes of traffic safety violations.

Paper [2] identifies the risk of adverse events as one of the main problems of modern production and the main criterion for the realisation of danger. The authors propose the use of risk management as a promising direction in the development of transport systems, which will allow stabilising and increasing the efficiency of their activities. The starting point of effective risk management in the management of transport processes at an enterprise is the construction of an effective risk management system. However, at present, there is almost no information on risk management in railway transport.

Paper [3] identifies the most problematic areas in the technological process of maintenance and offers an example of a management solution to prevent them. The problem is defined as the search for an effective way to manage the process of maintaining alarm systems in the required technical condition. It is proposed to use the method of searching for hidden bottlenecks based on the analysis of failure statistics as risks and mitigation. The carried out research has identified a disadvantage of the methodology in the form of the need to accumulate failure statistics and continuous monitoring of the risk management programme. Also, the identified advantages of the methodology allow us to assert that the proposed approach will be able to solve the problem of substantiating the most significant problem areas of the process of ensuring the operability of railway automation systems. In order to eliminate the identified shortcoming of the methodology, it is proposed to develop appropriate software with the help of which the statistical base will be accumulated automatically. The solution to the problem is proposed in the form of time planning for monitoring the most dangerous causes of failures.

Thus, statistical methods are the most effective in the management of organisational structures. It is proposed to adapt the obtained results into a form familiar to managers for widespread use in practice.

Untimely update of the Order of the Ministry of Infrastructure "On Approval of the Unified Form of the Act Drawn Up on the Results of a Scheduled (Unscheduled) State Supervision (Control) Measure on Compliance by a Business Entity with the Requirements of Legislation, Norms and Standards in the Field of Railway Transport, and the Form of the Order to Eliminate Violations Identified During a Scheduled (Unscheduled) State Supervision (Control) Measure on Compliance by a Business Entity with the Requirements of Legislation, Norms and Standards in the Field of Railway Transport".

The lack of an effective mechanism for bringing to justice officials responsible for traffic safety at railway transport enterprises and, as a result, their failure to fulfil the obligation established by the Order of the Ministry of Infrastructure of Ukraine No. 842 "On Approval of the Regulation on the Traffic Safety Management System in Railway Transport" of 24 December 2020 [5] to implement a traffic safety management system at the enterprise.

Thus, the problem of qualitative assessment of the impact of the regulatory act "Regulation on the Railway Transport Safety Management System" and assessment of the results of the implementation of the regulatory act and the degree of its implementation remains quite relevant due to the slow pace of implementation of the safety management system by railway transport enterprises.

The purpose and objectives of the study. The purpose of the article is to demonstrate in practice such an important aspect of the implementation of state-level regulatory documents as regulatory analysis of a document before its submission for approval and assessment of the results of implementation of a regulatory act and the degree of achievement of certain goals. Objectives of the article: 1 - to analyse the scope and number of Ukrainian enterprises which are subject to the Regulation on the Railway Transport Safety Management System; 2 - to determine the most rational of the alternative ways to achieve the objectives of state regulation; 3 - to determine the performance indicators of the regulatory act; 4 - to assess the result of implementation of the regulatory act and the degree of achievement of the defined objectives using the statistical method.

Materials and methods of research.

1. Analysis of the scope and number of Ukrainian enterprises that are subject to the Regulation on the Railway Safety Management System.

The following factors have a direct impact on the level of railway safety:

- technical condition of the rolling stock;
- interaction of the carrier with other business entities that have their own rolling stock (mutual coordination of actions).

Personnel involved in the departure of rolling stock (wagons, tanks, etc.) owned by the business entity on public tracks must responsibly and systematically maintain a high level of safety at the enterprise, and the business entity must ensure that the requirements for personnel, rolling stock, shunting operations and other components of traffic safety are met in accordance with the law.

Table 1 provides information on the Ukrainian enterprises that fall within the scope of the RRMS Regulation. It should be noted that this analysis was carried out before the full-scale invasion of Ukraine by the Russian Federation.

Table 1. Characteristics of railway transport enterprises to be covered by the Regulation on the RMS

Indicator.	Large	Medium	Small	Micro	Together
Number of business entities subject to regulation	9	1438	-	-	1517
Share of the group in the total number, %.	5,2	94,8	-	-	100

The problem of railway traffic safety is exacerbated by the lack of a single regulatory act that would regulate a unified approach of business entities to ensuring the safety of train traffic on railway transport, as well as the lack of a definition of what constitutes a railway traffic safety management system at the level of the Law of Ukraine "On Railway Transport".

However, during 2021-2023, several draft laws were registered in the Verkhovna Rada of Ukraine that raise the issue of a unified approach to ensuring train safety on rail transport through an effective safety management system:

- Draft Law on Amendments to the Code of Ukraine on Administrative Offences to Strengthen Administrative Liability for Violation of Legislation on Road, Urban Electric and Railway Transport [6], the adoption of which will resolve the issue of expanding the circle of persons subject to liability, which will ensure compliance with the law by all business entities in the field of road, urban electric and railway transport and the filling of the State Budget of Ukraine.

- The Draft Law on Amendments to the Law of Ukraine "On Railway Transport" on Certain Issues of Railway Safety Management [7], which was developed to create legal certainty regarding the term "traffic safety management system", define the content and the central executive body responsible for developing the regulation on the SMS, as well as establish exhaustive grounds for prohibiting the operation of railway rolling stock and railway transport infrastructure;

- Draft Law on Amendments to Certain Laws of Ukraine on Improving Safety in Railway Transport [8] aims to regulate the issues of stable annual funding allocated by railway transport enterprises for traffic safety in the amount of at least 1% of gross income for the previous year (analogous to the article on labour protection, where the employer is obliged to spend 1% of the gross income on labour protection), as well as to introduce provisions that will make it impossible to accept railway infrastructure elements for scrap.

It should be noted that currently, the requirements for rolling stock and personnel training are already enshrined in legislation and regulations, for example [10-15], etc., but their distinction and lack of systematic control at enterprises leads to accidents and material losses for both the carrier and business entities.

The Regulation on the train safety management system at the State Administration of Railway Transport of Ukraine [16] was outdated, its content, terms and requirements did not meet the requirements of national and European legislation.

The first step to improve the level of traffic and shunting safety in railway transport was the introduction of a European-style traffic and shunting safety management system for railway transport by adopting the Regulation on the Traffic Safety Management System for Railway Transport, which in turn will make it possible to develop effective preventive measures to prevent similar events in the future, prevent human casualties, and monitor the state of traffic safety in railway transport.

Based on the above, it can be concluded that the RDRS Regulation affects individuals, the state and business entities in Ukraine.

The objectives of state regulation are:

- Improving the procedures for hazard identification, risk assessment, and determining traffic safety measures at railway transport enterprises;

- Improving programmes to train staff (employees and managers) in traffic safety;

- improving the procedures for documenting information on traffic safety and shunting operations;

- Improving the procedures for reporting, recording and official investigation of transport accidents at railway transport enterprises;

- improving internal audit procedures for traffic safety and shunting operations at railway transport enterprises;

- implementation of the state policy on railway safety.

These goals and objectives are achieved by adopting a regulatory act.

2. Determining the most rational of alternative ways to achieve the goals of state regulation.

There are different ways to achieve improvements in road safety and its management. Table 2 summarises these alternative ways.

Table 2. Identification of alternative ways to achieve the goal of improving road safety management

Type of alternative	Description of the alternative
Alternative 1	<i>Preservation of the situation that existed at the time of the preparation of the Regulation on the SBRS.</i> This has led to a further gap in the railway safety legislation.
Alternative 2	<i>The adoption of a regulatory act</i> meets the objectives of state regulation, as well as the needs to address certain problems, and is a reasonable and effective way to achieve the objectives. This method is the most acceptable as it will achieve the goals of state regulation. This will improve the level of safety and management of train traffic safety, which will help reduce accidents, save lives and health of citizens, and the integrity of cargo .

Other methods that do not involve the adoption of a regulatory act are unacceptable, as the solution to the problem lies primarily in the legal sphere.

Tables 3 - 5 provide an assessment of the impact of the alternative ways of achieving improved road safety management from Table 2.

Table 3: Assessment of the impact of alternatives for improving train safety management on the sphere of state interests

Type of alternative	Benefits.	Costs.
Alternative 1	-	Reduction in state budget revenues due to increased accidents on the railway transport, which will lead to a deterioration in the economic situation in the field of passenger and cargo transportation
Alternative 2.	a) formation and implementation of the state policy on improving traffic safety, b) growth of foreign investment as a result of harmonisation of the requirements of the legislation in this area with the European one, c) increase in the number of business entities, d) fulfilment of Ukraine's international obligations, e) sustainable revenues to the State Budget of Ukraine, f) availability of jobs, g) satisfaction of the needs of society and the economy	-

Table 4. Assessment of the impact of railway safety improvement alternatives on the sphere of public interest

Type of alternative	Benefits.	Costs.
Alternative 1	-	a) increased risk to the life and health of citizens due to increased risks of transport accidents; b) increased risks of property loss; c) increased environmental damage.
Alternative 2	For citizens-passengers: a) use of railway transport services, b) the possibility of obtaining higher quality and safer services by reducing the risk to life and health due to the reduction of transport accidents. For citizens transporting goods and those living near railway tracks: a) reducing the risk of property loss; b) reducing environmental damage as a result of transport accidents	-

Table 5. Assessment of the impact of alternatives for improving railway transport management on the sphere of interests of business entities

Type of alternative	Benefits.	Costs.
Alternative 1	-	Increase in expenses due to emergency events: loss of cargo, rolling stock repairs, compensation for late and poor quality services.
Alternative 2	Improving the level of traffic safety during the transportation of passengers and goods will contribute to: a) improving the quality of services provided; b) creating favourable conditions for development, including the possibility of opening a new or expanding an existing business; c) reducing costs due to accidents: compensation for damage to human health, property, rolling stock.	Large and medium-sized businesses will bear the costs of implementing the SMS only to create a traffic safety service in case of its absence, or to entrust its functions on a contractual basis to the traffic safety service of the enterprise whose infrastructure they use or interact with (about UAH 300 thousand per year for two employees).

We will evaluate the preferences of alternative options for improving the situation with railway safety management by scoring on a scale:

- 1 point - the situation does not change;
- 2 points - minimal improvement;
- 3 points is an average improvement;
- 4 points - the situation has changed significantly for the better.

Table 6 presents the results of the assessment of alternatives to the traffic safety situation presented in Table 1.

Table 6. Performance rating - achievement of goals in solving the problem of railway transportation safety management

Name of the alternative	Performance score	Comments on the assignment of the corresponding score
Alternative 1	1	The absence of an effective mechanism for improving the safety of freight and passenger transportation at railway transport enterprises will lead to a deterioration in the state of safety of railway transport, and therefore to: damage to rolling stock, increased property losses of shippers and consignees, increased harmful impact of transport on the environment.
Alternative 2	4	a) introducing an effective mechanism to ensure traffic safety at railway transport enterprises; b) as a result of streamlining traffic safety procedures at railway transport enterprises, the level of traffic safety in the transportation of passengers and goods will increase, and therefore property losses will decrease: - from the repair of rolling stock and infrastructure, - shippers and consignees; c) harmonisation of Ukrainian legislation with the European one in the area of introducing safety management systems at railway transport enterprises will simplify the procedure for Ukrainian railway transport enterprises to enter the European market.

Table 7 shows the integrated result of the selection of alternative options for the development of the traffic safety management system.

3. Determination of performance indicators of the regulatory act.

First, let us identify the mechanism and measures that will ensure the solution of the problem. The mechanism that will ensure the resolution of the problem is the adoption of a regulatory act. The draft Regulation on the RMS proposes:

- Improving the procedures for hazard identification, risk assessment, and determining traffic safety measures at railway transport enterprises;
- Approval of methodological recommendations for building an enterprise's RMS;
- Improving programmes to train personnel (employees and managers) in traffic safety for mainline and shunting operations;
- Improving the procedures for documenting traffic safety information for mainline and shunting traffic;
- Improving the procedures for reporting, accounting and internal investigation of transport accidents;
- improving internal audit procedures for traffic safety;
- implementation of the state policy on railway safety.

Table 7. Rating of the effectiveness of applying alternative options for the development of the situation with the traffic safety management system in the railway transport sector

Name of the indicator	Alternative	
	1	2
Benefits (summary)	-	<u>For the state sector:</u> a) formulation and implementation of the state policy on improving the level of railway transport safety, b) growth of foreign investment as a result of harmonisation of legislation in this area with the European one, c) an increase in the number of business entities, d) Ukraine's fulfilment of its international obligations, e) sustainable revenues to the State Budget of Ukraine, f) availability of jobs, g) meeting the needs of society and the economy. <u>For the sphere of citizens:</u> a) ensuring the use of railway transport services as passengers; b) the possibility of receiving better and safer services by reducing the risk to life and health; c) for freight carriers and those living near railway tracks - reducing the risk of property loss and environmental damage; <u>For business entities:</u> a) creation of favourable conditions for development, in particular, starting a new business or expanding an existing one; b) prevention of expenses resulting from emergency events: compensation for damage to human health, property, and rolling stock.
Expenses (total)	a) a possible decrease in revenues to the state budget due to an increase in railway accidents; b) deterioration of the economic situation; c) increased risk to the life and health of citizens as a result of increased risks of transport accidents; d) an increase in property losses and environmental damage as a result of transport accidents on the railway; д) Increase in expenses due to emergency events: loss of cargo, rolling stock repairs, compensation for untimely and poor quality services.	Large and medium-sized businesses will bear the costs of implementing traffic safety management systems only for the establishment of a traffic safety service, in case of its absence, or for contracting the traffic safety service of the enterprise whose infrastructure is used or with which the enterprise interacts (up to UAH 300 thousand per year).
Overall rating result	Does not achieve the goals of state regulation	The adoption of the regulatory act will ensure the achievement of the set goals

Measures proposed to be taken by the executive authority to resolve the problem:

- methodological recommendations for conducting internal investigations at enterprises;
- methodological recommendations on the implementation of internal audit at enterprises;
- methodological recommendations for the development of quality indicators (standards) of traffic safety at enterprises;
- to ensure that business entities and the public are informed of the requirements established by the regulatory act by publishing them.

Measures proposed by business entities to address the problem:

- to get acquainted with the requirements of the regulatory act;
- in the absence of a traffic safety service at the enterprise, or to entrust the performance of its functions on a contractual basis to the traffic safety service of the enterprise whose infrastructure is used or with which the enterprise interacts;
- develop a traffic safety management system and coordinate it in terms of procedures for interaction with other companies whose infrastructure or rolling stock it uses.

There are no risks of external factors affecting the effect of the regulatory act.

No possible damage is predicted in the event of the expected consequences of the regulatory act.

The adoption of the regulatory act will help to preserve the ability of business entities to conduct competitive business, sustainable revenues to the state budget, the availability of jobs and meet the needs of society and the economy.

The implementation of the regulatory act will not require additional costs and resources of the executive authorities.

The regulatory act is expected to enter into force six months after its official publication. It is proposed that the term of the regulatory act should not be limited in time.

Let's define the performance indicators of the regulatory act.

1. The number of business entities engaged in economic activity in the field of railway transport to which the act applies.

The regulatory act will apply to railway transport enterprises engaged in the carriage of passengers and/or loading, transshipment, unloading of cargo by rail. The estimated number of such business entities is 1517.

The number of business entities may increase due to the harmonisation of Ukrainian legislation with EU legislation and the introduction of a European approach to regulating the procedures for ensuring the safety of railway transport. The introduction of European-style traffic safety management systems by railway transport companies may encourage businesses from the EU, the US, and other countries to open businesses related to the transportation of passengers or goods by rail in Ukraine.

2. The emergence of European railway transport operators on the Ukrainian market.

3. A relative decrease in the number of transport accidents at railway transport enterprises.

4. The amount of revenues to state and local budgets and state trust funds related to the regulatory act will not change.

5. The level of awareness of business entities is average. The draft act and the relevant regulatory impact analysis are published on the official website of the Ministry of Infrastructure of Ukraine in the section "Activities" - "Regulatory Activities".

Define the measures that will be used to track the effectiveness of the regulatory act.

The Ministry of Infrastructure of Ukraine will monitor the effectiveness of the regulatory act.

The baseline performance tracking of the regulatory act will be carried out after the regulatory act enters into force, but no later than the day on which the repeated performance tracking begins.

The effectiveness of the regulatory act will be monitored again one year after its entry into force, but no later than two years after the date of entry into force of this act.

Periodic monitoring of the effectiveness of the regulatory act will be carried out once every three years, starting from the date of completion of the re-monitoring of the results of this act.

4. Evaluation of the results of the regulatory act implementation and the degree of achievement of the set goals.

The criterion for assessing the effectiveness of the implementation of the act is to reduce the number of transport accidents at railway transport enterprises. Since tracking the effectiveness of the Order, namely from 09 October 2021, based on the statistical method, according to information from official sources, the number of transport accidents in comparison with 2022 to 2021 has almost halved in 9 months - 408 against 869. However, to claim that the dynamics are positive, we need to study not only quantitative indicators, but also qualitative ones.

It should also be noted that official sources do not contain information on the number of railway transport enterprises that have implemented a traffic safety management system. In the author's opinion, only 5% of enterprises have implemented the SMS and less than 1% of enterprises have mutually agreed the SMS with JSC Ukrzaliznytsia.

The Ministry of Infrastructure of Ukraine assesses the results of the implementation of the regulatory act and the degree of achievement of the set goals positively.

Conclusions. Based on the analysis of the activities of railway transport enterprises, 1517 enterprises were identified that are subject to the Regulations of the Railway Safety Management System. These are companies that own or use railway rolling stock or railway infrastructure.

Out of two alternative options for solving the problem of improving the level of train safety through a comparative analysis of the impact on the interests of citizens, the state and business in Ukraine, the draft Regulation on the SBS was selected.

The regulatory act's performance indicators are defined, such as improving hazard identification procedures, risk assessment, developing training programmes on traffic safety for three categories of employees, improving procedures for documenting traffic safety information, introducing an internal audit on traffic safety, and implementing the state policy on traffic safety in railway transport.

The results of the implementation of the regulatory act and the degree of achievement of the set goals were assessed. The number of transport accidents in the first nine months of 2022 decreased by almost 2 times compared to 2021, but not only quantitative but also qualitative indicators should be analysed. The level of traffic and transportation safety is increasing as a result of the introduction of the SMS at railway transport enterprises, which means that the risk of deaths and injuries in railway transport is decreasing. However, the growth rate is slow, with only 5% of railways having developed and implemented an SMS.

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Аналіз регуляторного впливу Положення про систему управління безпекою руху на залізничному транспорті

Стаття присвячена дослідженню, яке досить рідко зустрічається у науковій технічній літературі. Мова йде про аналіз впливу нормативно-правового документу «Положення про систему управління безпекою руху на залізничному транспорті» на групи населення та підприємства України та його результативність після затвердження. Ці два аналізи проводяться до і після затвердження нормативних документів у державних органах влади (міністерствах, Кабінеті Міністрів, тощо). Актуальність такого Положення пояснюється необхідністю імплементації нормативних документів європейського типу у діяльність українських залізниць. Імплементація відповідає Угоді про асоціацію між Україною та ЄС. Особливість Положення відповідно до існуючого досі пояснюється тим, що воно стає обов'язковим не тільки для АТ «Українська залізниця», але також для підприємств, які у своїй діяльності використовують залізничний рухомий склад та залізничну інфраструктуру. Виявлено що до сфери залізничного транспорту підпадають 1517 підприємств. На основі аналізу впливу Положення про систему управління рухом на залізничному транспорті на інтереси громадян, держави та суб'єктів господарювання було прийнято висновок щодо найбільш раціонального варіанта досягнення мети з підвищення рівня безпеки руху залізничного транспорту. Таке Положення було затверджено Міністерством інфраструктури у 2021 році.

Ключові слова: безпека руху, залізничний транспорт, регулювання, аналіз, оцінка, управління, ризик