Creation of a mobile application for digitizing technological processes of a railway station

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Abstract. The article considers the main directions of improving the traffic safety management system in railway transport in the context of the transition to a higher level of reliability. The transition of the railway industry from information control systems to fully control systems can be ensured by combining automated information systems that are integrated on the road network into production processes. Within the framework of the project to ensure the safety of the transportation process, it is advisable to provide for the implementation of work on equipping the infrastructure of JSC Russian Railways with modern innovative technical means - automated systems for inspecting trains and wagons using laser scanners. The work of the complex to identify and prevent situations that threaten the safety of traffic along the route is considered, the introduction of which will ensure the transition to unmanned technologies when organizing the control of goods and rolling stock at loading stations and along the route. The use of the resource mobile workstation of a cargo and baggage pick-up unit at a railway station will speed up the process of accepting wagons for transportation, reduce the time for processing transportation documents, improve the quality of the railway station, significantly optimize the work process of a cargo and baggage pick-up unit, increase labor productivity, eliminate the influence of the human factor in carrying out this type of work. The technical and economic result of using this complex at the railway stations of Russian Railways is the provision of an increased level of safety on the railways.

1. Introduction
The leading directions of the policy of the holding company Russian Railways in the field of information technology are import substitution and customer focus, the prospects for the development of these areas are laid down in the company's IT strategy, which will be formed this year. Stable, uninterrupted, efficient operation of the railway network can be provided by a single information complex of control and data processing systems.

The transition of the railway industry from information control systems to fully control systems can be ensured by combining automated information systems that are integrated on the road network into production processes. JSC "Russian Railways" acts as a driver for the development of modern technologies in the transport sector, aiming at increasing efficiency in organizing the transportation process [1].
2. The main directions of improving the traffic safety management system

In order to move to a higher level of reliability in the field of traffic safety, the industry has identified the following stages:

- ensuring the safety of life, health of employees and users of services;
- ensuring a given level of traffic safety that meets international and national standards;
- ensuring the safety of cargo, rolling stock, infrastructure and technical means;
- minimization of consequences from transport accidents and risks of all categories.

This goal is achieved by solving the following tasks:

- implementation of the system of access to the infrastructure of JSCo Russian Railways;
- bringing the infrastructure of Russian Railways in line with the requirements of the technical operation rules;
- risk management in the field of traffic safety;
- development of a traffic safety culture in the industry [1-4].

In 2019, the number of traffic accidents and other events committed on the railway transport infrastructure decreased by 16% compared to the level of 2018, including those caused by the Russian Railways holding - by 14% [2, 5, 6]. A risk-based approach to control measures, taking into account the ranking of transport market participants by groups of operational risk, as well as the implementation of the roadmap for ensuring functional traffic safety in the Russian Railways holding, which defines general methods and requirements for traffic safety management on the infrastructure of Russian Railways, including active preventive measures to reduce accidents, Figure 1.

**Figure 1.** The number of traffic safety violations at the infrastructure of Russian Railways.

The traffic safety indicator for the Russian Railways holding in 2019 amounted to 0.98 traffic safety violations per 1 million train-km, which is 23% better than the planned target (1.28) and 16.5% better than the 2018 indicator (1.17). These results were achieved by monitoring the compliance of the participants in the process with regulatory rules and the use of progressive methods of safety management [3, 7].

The main directions of improving the traffic safety management system are:
coordination of interaction between all functional branches, their structural divisions and subsidiaries involved in the transportation process, based on unified approaches to the management of processes related to traffic safety;

implementation of approaches and requirements, harmonized with international standards;

maintaining a positive level of traffic safety culture through the awareness of the holding's employees of the importance and social responsibility when performing work that affects traffic safety, with the synchronous integration of mandatory and strict rules of conduct in all production processes; improving the regulatory framework.

Within the framework of the project to ensure the safety of the transportation process, it is advisable to provide for the implementation of work on equipping the infrastructure of JSC Russian Railways with modern innovative technical means - automated systems for inspecting trains and cars using laser scanners [7-10].

### Table 1. Data for identifying cause-and-effect relationships of admission at points of commercial inspection of cars (PCI), rolling stock with commercial malfunctions.

| Reasons | Number of uncoupled cars for the specified reason | % violations | Accumulated % |
|---------|--------------------------------------------------|--------------|---------------|
| 1. The use by the consignor of low-quality fastening props | 29 | 45 | 45 |
| 2. Concealed by the consignor defects of stowage and fastening | 17 | 26 | 71 |
| 3. Malfunction of ASKO PV, ASKO SV | 6 | 9 | 80 |
| 4. Failure to fulfill official duties | 5 | 8 | 88 |
| 5. Latent commercial faults | 4 | 6 | 94 |
| 6. Incorrect registration of the circumstances of the commercial malfunction of the car by the employees of the violation detection station | 4 | 6 | 100 |

### 3. Integration of information systems on a mobile workstation of a cargo and baggage acceptance receiver at a railway station

A mobile workstation for a cargo and baggage pick-up at a railway station, as the main structural unit of railway transport for the smooth organization of the transportation process, should provide the following basic functionality:

1. Integration with ACS ST, EASAPR M, AS ETRAN, etc. in terms of data exchange for the formation and signing of electronic documents using a simple electronic signature;

2. Formation, execution and receipt of electronic documents within the business processes of the station, including the process of processing trains in the parks of stations and wagons on public and non-public tracks;

3. Formation and correction of all necessary fields, registration and signing with an electronic signature of primary documentation: GU-45VTs, GU-23VTs (for all types of acts), VU-14 IEC;

4. Voice control of calling forms, speech formation and speech correction of form fields;

5. Obtaining a sorting sheet, all types of shunting plans for the compiler in the parks of stations, automated formation of the results of fixing the brake shoes in the register;

6. Familiarization with telegrams, normative documents, request for information and necessary documentation for trains and wagons, incl. GU-26 notifications;

7. End-to-end user authentication (without re-authorization in adjacent systems, including in the electronic signature system).
Figure 2. Diagram of the causal relationships of the admission to the PCI of cars with commercial malfunctions that threaten train traffic safety.
Figure 3. Basic functionality and example interface.

The mobile workstation of the cargo and baggage acceptance receiver of the railway station is a smartphone of standard dimensions 185x65 mm with a cover that does not fully provide protection from atmospheric precipitation [11, 12].

Let us consider the algorithm of work on the example of forming a reminder for the supply of freight cars to the fronts of loading and unloading operations. The process is implemented as follows [13-17].

The interface for issuing a reminder for the delivery of wagons through the mobile workstation of the cargo and baggage acceptance receiver of the railway station:

1. On the main screen, select the "Feed" mode;
2. Choose the place of delivery, the client;
3. Select the list of wagons by selecting the list of feeds;
4. Mark the necessary cars and save, after which the printing form GU-45 is formed;
5. Click on the "Sign" icon and enter your login and password information in the authentication window.

A memo for cleaning freight cars to the fronts of loading and unloading operations is formed in a similar way.

Voice control is implemented in the mobile workstation of the cargo and baggage receiver of the railway station. And it is also possible to obtain information about the coordinates of the location of the rolling stock on the tracks of the railway station itself and the tracks of non-public use, as well as to search for a package of documents drawn up for certain freight cars. The station employee can request information on the results of the technical and commercial inspection of freight cars located at the railway station and non-public tracks, enter data on the results of the commercial inspection. Information on the technical suitability of the cars is entered by the employee of the carriage depot. In the presented automated system, it is possible to enter information used by workers in the movement shop (fixing, sorting sheets, and so on).

In order to increase the efficiency of the use of the mobile workplace of the cargo and baggage acceptor at the railway station, it is necessary to implement the function of drawing up transportation documents in the "Autoagent" mode, as well as to provide railway station employees with the opportunity to use the ASK NTU resource on the mobile workplace of the cargo and baggage acceptor when checking the correct placement and securing cargo in wagons and containers in accordance with the current Specifications, Figure 4 [2, 12, 18, 19].
**PERFORMANCE**

High performance due to the Qualcomm 8953 chipset

| PERFORMANCE | CONVENIENCE OF USE | INDUSTRIAL PROTECTION |
|-------------|--------------------|-----------------------|
|             | Battery 4000 mAh, removable frost-resistant battery will allow you to work up to 20 hours at a temperature of 20 °C and up to 15 hours at a temperature of -20 °C | Operating temperature range from -20 °C to +60 °C |
| LTE signal reception cat. 7 to 300 mbps. 1.9x better than a regular smartphone | The screen can be operated with gloves and remains legible in direct sunlight | Impact resistance from a height of 1.5 meters |
| An additional navigation chip provides multisystem coordinate reception with an accuracy of 1 meter | The device has a chipset for connecting a variety of accessories: video camera, thermal imager, smart card reader and others | Dust and moisture protection according to IP67 standard |

**INDUSTRIAL PROTECTION**

| Model - industrial smartphone MIG C55 | The platform is being developed and adapted on the territory of the Russian Federation | Retail price on the website of the official supplier Mobile Inform Group from 71,990 rubles |

**Performance and Convenience of Use**

In order to automate the technological processes of the line employee of the station - the acceptance of cargo and wagons for transportation, the formation of electronic documents with the possibility of their prompt signing with an electronic signature:

- GU-36 / VCE - weighing book on wagon scales;
- GU-37 / VCE - book for sealing wagons and containers;
- GU-78 / VTSE - book for registering control overweight of cars;
- GU-2VTsE - a book of notification about the time of car delivery for loading / unloading.
- GU-2aVTs - a book of notifications about the completion of a cargo operation or transfer of cars to the exhibition track.

It is worth noting the ability of the device to receive a 4G signal up to 300 Megabits per second, which significantly exceeds the capability of conventional smartphones (1.9 times) [2, 12, 18].

**4. Directions of digitalization of technological processes at railway stations**

The plan provides for three areas of digitalization of technological processes:
1. Automatic formation of a plan for the supply of freight trains. This direction is based on the integration of information systems of the client and JSC Russian Railways (ACS MR) in terms of the reciprocal exchange of information about the approach of trains with cargo to the clients, the availability of free tanks and storage space on non-public tracks, the supply of vehicles, etc.;

2. Automation of shunting work. This direction provides for the adaptation of the station operation technology to the principles of automatic formation and execution of work orders for shunting operations;

3. Expansion of technological electronic document management.

5. Conclusion

The use of the resource mobile workstation of a cargo and baggage pick-up unit at a railway station will speed up the process of accepting wagons for transportation, reduce the time for processing transportation documents, improve the quality of the railway station, significantly optimize the work process of a cargo and baggage pick-up unit, increase labor productivity, eliminate the influence of the human factor in carrying out this type of work.

The technical and economic result of using this complex at the railway stations of Russian Railways is to ensure an increased level of safety on the railways, due to:

- expanding the function of monitoring malfunctions and going beyond the gauge of railway cars or cargo;
- improving the quality of inspection;
- increasing the predictability of violations of train traffic safety;
- reducing the cost of operating infrastructure and rolling stock [2, 5].

According to preliminary calculations, the cost of the device will be 72 thousand rubles in the basic configuration [3, 11].

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