Software for automated supervisory control of navigation system and accounting of road transport for the Northern regions of the Russian Federation

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Abstract. Nowadays there is the following mechanism for collecting information on imported cargo: information from a way-bill; cargo receipt; way-bills per day; transmission of information to accounting department. This collection mechanism does not ensure the convenience of their use and processing. In addition, the efficiency of the data is not ensured, since the necessary information is received for processing only the next day. The aim of the work is to develop a standard configuration of workstations and justification of their functions. Methods of collecting and analyzing data on the operation of automated systems, as well as methods of configuration and rationalization are used in the work. The result of the work is a compiled and justified model of the configuration of the automated control system and justification of the importance of its application.

1. Introduction
Nowadays it is technically possible to use global navigation satellite systems - GLONASS, GPS and GALILEO in connection with new technologies in transport. The order of the Ministry of Transport of the Russian Federation No. 141 dated 10.01.2007 approved by the Government of the Russian Federation by Resolutions No. 896 dated 08.03.99, No. 323 dated 04.30.2008, No. 641 dated 08.25.2008, and the Federal Law of the Russian Federation No.22-FL, dated 02.14.2009, “On navigation activity” determined that navigation systems used in the transport complex of the Russian Federation should necessarily apply the GLONASS system.

The use of modern computer facilities is a necessary condition for the improvement of the analysis of production and economic activities of transport companies [1-3]. Great importance is attached to the competence of managerial work as a means of increasing its efficiency, reducing labor and time costs.

An employee keeping a record of the delivered cargo takes a lot of time to extract the necessary data. Consequently, there is little time left for analyzing information and making operational decisions, and this is fraught with emergence of an emergency situation in the Northern regions.

The software for automated navigation system for dispatching control and accounting of the operations of road transport for the Northern regions of the Russian Federation is not just the improvement and efficiency of cargo transportation, but also one of the most important tasks for the survival of people who live and work in these conditions for the benefit of Russia [4-9].

The need to develop and implement an automated control system, in particular the structure of its work, is a priority for the organization of cargo transportation. The aim of the work is to develop a standard configuration of workstations and justification of their functions.
2. Composition of main functional subsystems and automated workplaces of specialists

The software for automated navigation system for dispatching control and accounting of the operations of road transport is intended for automation of dispatch control processes of the transportation. In accordance with [19], the composition of the main functional subsystems of the dispatching control system of cargo transportation includes the following subsystems:

- “Operational planning of transportation”;
- “Automated accounting, control and analysis of freight traffic”;
- “Operational dispatch control”;
- “Operational traffic analysis”;

In the basic (typical) configuration of the system, the tasks of these subsystems are realized by typical configurations of automated workplaces (AWP) consisting of:

- “Dispatcher AWP”;
- “Technologist AWP”;
- “Head AWP”;
- “System administrator AWP”; [10,11,12]

3. Assignment of automated workplaces of specialists

3.1. The assignment of dispatcher AWP

Dispatcher AWP is intended for automation of the functions of operational dispatching control. The main functions of the dispatcher's workstation:

1) Formation of operational tasks and route.
2) Formation and printing of a way-bill.

Formation (occurs automatically) and updating the information of the route sheet and printing it out; When printing a route sheet, the driver is indicated with the places and times of arrival. A fragment of an electronic map with a specified route is printed, the passage of which is automatically controlled.

3) Dispatching control and regulation of the transportation process, including visual display of movement on tasks in tabular form (changing the color of cells upon arrival, delay) with a display relative to the current time of day;
4) Control over the time of transport operations, including: determination of the actual arrival time of vehicles; determination of the actual time of departure of the vehicle from the facility upon completion of the transportation work; determination of the actual duration of the vehicle at the facility (if the actual idle time of the vehicle at the facility exceeds the established standard, the dispatcher receives a corresponding message).
5) Control of vehicle traffic on a route, including: fixing speeding; fixing a deviation from the route; fixing a violation of the planned sequence of passing checkpoints; fixation of the location outside the designated control points.

If there are situations of unauthorized departure from the route line established in the route sheet, the dispatcher receives a corresponding message indicating the vehicle identification parameters, deviation values and time parameters.

The tabular form of dispatcher AWP displays the status and location of the vehicle relative to the parking facilities / infrastructure objects, etc. The "hot messages" window contains information about violations of the established norms of time for operations, violations of the speed limit, deviations from the planned route of movement, etc.

6) Visual display of the movement of an individual vehicle in a tabular form (changing the color of cells when the state of the vehicle changes) with display relative to control points; visual display of routes and vehicles on the map; voice communication and SMS exchange directly from the program (if there is a GSM modem connected to the computer). This also includes the regulation of the transportation process, including changing the operational plan for the vehicle; analysis of information on violations of the transportation process.
7) Continuous monitoring of the main operations of the transportation process allows detecting violations, to establish the causes and culprits, and to apply measures to eliminate deviations from the plan.

8) Formation of operational certificates and reporting forms on the current state of implementation of the transportation plan.

9) Analysis of negotiations on air.

All negotiations on the air between dispatchers and drivers are recorded and can be reproduced by the dispatcher when considering disputed or unclear situations.

The basic functionality of the system provides the possibility of automatic route development (similar to GoogleMaps, Yandex). The basic interface provides the ability to manually adjust the traffic route with the ability to automatically print a route sheet.

The main screen of the dispatcher AWP displays the progress of the planned transport work, the actual state, as well as a window of "hot" messages about violations. [13]

3.2. The assignment of technologist AWP

The workplace of the technologist is intended for the formation of a database of regulatory and reference information, the analysis of the work of vehicles on given tasks and the resolution of disputable situations. For this purpose, the workplace of the technologist provides the following functions:

1) Technological preparation of the operational management cycle:
   - Formation and adjustment of special control points

2) The analysis of the work of vehicle on the given tasks and the resolution of disputable situations, including viewing of the log of abnormal situations.

The technologist has the ability to track the location of the traffic of controlled vehicles using an electronic map. This occurs either in real time or in the past period using the navigation data archive.

3) Formation of a set of tabular and graphical output forms.

There are a number of references for the analysis of the executed movement.

- The certificate of shift-day plan.
- The certificate of the implementation of the shift-daily plan. It reflects in detail for each item actual and planned time indicators, mileage and deviations.
- The certificate of driver’s work. It displays the decoding for each flight performed, for each control point, the actual and planned time indicators, mileage and speed, as well as summary indicators. A set of similar certificates for each driver's flight for a day is a confirmation of his work.
- The certificate of vehicle delays at the facilities. It contains data on vehicle delays at the facilities represented by the control points.
- The certificate of violations. It contains all the messages about the violations, indicating the time the system sent the message, and the comments to the message that the dispatcher made while processing the messages.

The control of the deviation from the route line can be organized only if the electronic map contains the layer "oriented road graph".

4) Formation and recording of specialized database directories, including the input and adjustment of regulatory and reference information. It is necessary for the formation of shift-daily assignments and control over the transportation process.

The regulatory and reference information includes the following references:

- Models of Transport: a universal guide to transport models;
- Vehicles: guide to the rolling stock of the company, working in the System;
- Drivers: a universal driver's guide;
- Directory of mobile equipment installed on vehicles;
- Directory of fixing mobile equipment for specific vehicles. It contains information about radio stations that are installed on vehicles operating in the system.
All negotiations on the air between dispatchers and drivers are recorded and can be reproduced by the dispatcher when considering disputed or unclear situations. [14]

3.3. The assignment of head AWP

Head AWP ensures the performance of control functions for critical indicators of the transportation process, a history of movement archive and emergencies.

The workplace of head provides the possibility of forming the following additional output forms:

- The certificate of vehicle delays at the facilities. It contains information about the delay time for each vehicle and the summary information.
- The certificate of scaling. It contains information on the violations of speed limits for the past operational day.

Moreover, the system provides information on the time of the violation, the duration of the movement with a violation of the speed limit, the average speed with violation. The system forms the results for each vehicle, which violated the speed limit and the results for the enterprise as a whole.

- The report "Actual fuel consumption for the period" contains information for the reporting period on the volumes at the beginning and end of the period, refueling, discharge and expenses for each vehicle.
- Reporting forms for fuel consumption by day.
- The report "Actual fuel consumption by day" contains information for the reporting period on volumes at the beginning and end of the period, refueling, discharges and expenses for each vehicle in the context of calendar dates.
- The report "Schedule of fuel level changes per day" shows the dynamics of fuel level changes per day for the selected vehicle. [15]

3.4. The assignment of system administrator AWP

The system administrator provides reliable operation of the whole system with the help of special software. He performs the following automated functions:

- Managing and copying system data;
- Control access to the system;
- Backing up the database;
- Restoring a database from saved copies;
- Database optimization;
- Formation and specification of the location of control points.

During the operation of the automated dispatching system, a large amount of data is received on the telematics server: navigational marks, route information, etc. Storage of data for all days in one place leads to a significant decrease in the speed of the system. In this regard, the system provides 3 different drives for data:

- The drive for settlement day
  The drive for the settlement day stores data for the current day. In addition the drive for those days, when it is necessary to present data for the formation of reporting forms. The administrator generates a complete list. All operational dispatch control is based on the data of this particular drive. Therefore, one of the important tasks of the system administrator is to check its status.
- The archive drive
  All other days are stored in this drive. You can get a reporting form for any day stored in the archive. A large number of days stored in the archive can lead to an increase in the size of the database on the disk of the file server; reduce the speed of obtaining reporting forms and the performance of the system as a whole. Therefore, another important task of the system administrator is to copy data to external media and clean the drive for archives from the "old days".
- The drive on disk
All information in the database is stored in a single large file. Therefore, if you want to write data for a particular day to an external storage, you should first get the data for that day as separate files, archive them, and then write the archive to an external storage medium. To perform this operation, you should use the data management and backup program.

4. Conclusion
Information network of the company allows providing the acceleration of information transmission, the possibility of rapid exchange of information between users, receiving and sending messages, without leaving your workplace. In addition, it allows exchanging information between computers of different manufacturers working under different software [16].

As a result, there is the urgent need for theoretical justification of ways to improve this efficiency by maximizing the automation of functions and operations of the dispatching staff. The solution of these problems is directly related to the development of mathematical models and methods for processing navigation data. In this case, it should be borne in mind that the "navigation" function in technical systems will become as massive as the "time" function in the past. This means that the navigational data will be used not only for solving dispatching tasks, but also for a wider range of new tasks, which in general can be called "technological".

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