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FEATURES OF THE SUBJECT AREA OF THE INFORMATION MODEL OF THE SYSTEM OF REMOTE MONITORING OF THE TECHNICAL CONDITION AND MODES OF OPERATION OF THE TRUCK

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Abstract

An integral element of the processes of management and communication support of modern transport and logistics systems is the use of remote information monitoring of the parameters of the technical condition in the operation of vehicles.

The task is to increase the efficiency of technical operation of trucks by improving the methods of operational control of the technical condition of the vehicle when changing modes of operation and rest and physical condition of drivers in operation by developing and applying information and analytical system of remote monitoring. The purpose of the study is to form a systematic interaction of monitoring tools to remotely ensure compliance with the modes of operation and rest of the driver, taking into account the technical condition of the vehicle in operating conditions, taking into account road, transport, climatic conditions, etc.

Keywords: information system, monitoring, mode of work and rest of the driver, technical condition, vehicle.

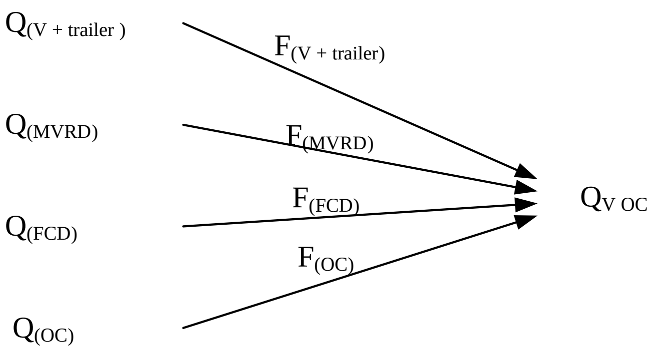
Obtaining the parameters of the technical condition of trucks, fuel consumption and speed in the practice of operation of trucks in Ukraine, pay enough attention. However, automated remote simultaneous combination of the obtained results with the operating conditions, operating and rest modes (MVRD) of the crews and their physical condition (FCD) has not been performed so far. It is difficult to analyze the change in the operating parameters of vehicles without accurate information about MVRD and FCD of vehicles. As a rule, this information is received by technical services gradually, with a significant delay [1] ;. Therefore, the owners of vehicles (transport companies) use only separate indicators of their work, combined with individual parameters of the MVRD. Observation and analysis of compliance with the MVRD in real operating conditions is carried out after the return of the vehicle from the flight. The practice of operation of freight vehicles requires remote operational monitoring of the parameters of the condition and fuel consumption of vehicles in accordance with the changes of MVRD and FCD, taking into account the operating conditions.

The article conducts a study that aims to develop an information-analytical system of remote monitoring, which allows remote monitoring of the technical condition of the truck, taking into account the MVRD and their operating conditions. The monitoring system covers the main objectives of the study in terms of forming an information model MVRD, technical condition of the vehicle, operating conditions of the vehicle and the possibility of remote assessment of changes in MVRD depending on the condition of the vehicle and FCD taking into account operating conditions [2].

Formation of a method of system interaction of parameters and model of remote monitoring of a technical condition of the cargo vehicle in operating conditions

The basis of the model for monitoring the parameters of the technical condition of the VEHICLE, MVRD, FCD is a general approach to the study of the system "Freight vehicle - trailer -FCD - MVRD - operating conditions - vehicle operation infrastructure", which includes system interaction of components (VEHICLE) and driver's trailer and information and communication complex (ICC); operating conditions of the VEHICLE (road, transport, atmospheric and climatic conditions and work culture) [3]; transport infrastructure and road infrastructure (1).

The formation of the model for monitoring the parameters of the technical condition of the VEHICLE, FCD, MVRD is shown in (1):



(1)

where, $Q_{(V + trailer)}$ - a set of models of parameters of the technical condition of the vehicle and trailer, $Q_{(MVRD)}$ - a set of models of parameters of the mode of operation and rest of the driver, Q (FCD) - a set of models of parameters of the physical condition models of parameters of operating conditions. $F_{(V + trailer)}$ - functional display of models of parameters of technical condition of vehicle and trailer, $F_{(MVRD)}$ - functional display of models of parameters of mode of work and rest of the driver, $F_{(FCD)}$ - functional display of models of parameters of physical condition of the driver, $F_{(OC)}$ - functional display of models of parameters of operating conditions.

Formation of the model of control of parameters of technical condition of vehicle, FCD, MVRD is shown in (2):

$$\begin{tikzcd}
 & Q'_{V} & \\
Q_{V\ OC} \arrow[ur] \arrow[r] \arrow[dr] & Q'_{MVRD} & Q_{Upr.VC} \arrow[ul] \arrow[l] \arrow[dl] \\
 & Q'_{FCD} &
\end{tikzcd} \qquad (2)$$

where, correction $Q_{Upr.VC}$ - a set of models of control parameters of the vehicle in operating conditions is possible with the help of: Q'_{MVRD} - change of crew; Q'_{FCD} - change of crew, vehicle stop.

Description of the general information model of the subject area of the system of remote operational control of the technical condition of the truck in the operating conditions

Models of the database of the information system of operative control of a technical condition and operating modes of the vehicle in the conditions of operation are developed [4] ;. The model of the subject area M_{zag} system for monitoring the parameters of the technical condition of the vehicle together with the tachograph, tracker and means of recording the physical condition of the driver is presented as the following set of components and components of the information system, namely the parameters of the technical condition of vehicle $M_{vehicle}$; modes of work and rest of the Mtg driver; additional parameters of the state of the vehicle, trailer, environmental performance of the vehicle Mtr and the physical condition of the driver MFCD. The formulas are presented in General:

$$M_{zag} = \begin{Bmatrix} M_{vehicle} \\ M_{tg} \\ M_{tr} \\ M_{FCD} \end{Bmatrix}_{vehicle} = \begin{Bmatrix} \langle O_{vehicle}, V_{vehicle\ in}, V_{vehicle\ out,} F_{vehicle}, H_{vehicle}, P_{vehicle}, R_{vehicle}, \rangle \\ \langle O_{tg}, V_{tg\ in}, V_{tg\ out}, F_{tg}, H_{tg}, P_{tg}, R_{tg}, \rangle \\ \langle O_{tr}, V_{tr\ in}, V_{tr\ out}, F_{tr}, H_{tr}, P_{tr}, R_{tr}, \rangle \\ \langle M_{FCD}, V_{FCD\ \ in}, V_{FCD_{out}}, H_{FCD}, P_{FCD}, R_{FCD} \rangle \end{Bmatrix} \qquad (3)$$

For the functional model of the subject area (3) it is possible to write the following dependences: $V_{\text{vehicle in}} = \{v_{\text{vehicle } l} | \in L_{\text{vehicle in}}\}$ – for many input information elements; $V_{vehicle\ out} = \{v_{vehicle\ l} | \in L_{vehicle\ out}\}$ – for many source information elements; $V_{vehicle} = V_{vehicle\ in} \cup V_{vehicle\ out}$ – for a complete set of information elements; $F_{vehicle} = \{f_{vehiclei} | i_{vehicle} = \overline{1, I_{vehicle}}\}$ – for many usage functions; $H_{\text{vehicle}} = \{h_{\text{vehicle}j} | j_{\text{vehicle}g} = \overline{1, J_{\text{vehicle}}}\}$ – for many data processing tasks of the parameter monitoring system; $P_{\text{vehicle}} = \{p_{\text{vehicle}k} | k_{\text{vehicle}} = \overline{1, K_{\text{vehicle}}}\}$ де, P – set of users (number and composition of personnel), which provides work with the system of monitoring the parameters of vehicle, tachograph, tracker, physical condition of the driver in the system of technical condition of the vehicle; $R_{vehicle} = \{r_{vehicley} | y_{vehicle} = \overline{1, Y_{vehicle}}\}$ – for many relationships. By analogy for M_{tg}, M_{tr} , M_{FCD}.

For formalized construction (description) and analysis of the information system for monitoring the parameters of the technical condition of the vehicle, with the installed tachograph, tracker and FCD analytical description of their semantics is performed using Boolean adjacency matrices describing the relationship Rvehicle, Rtg and Rtr R_{FCD} between Mvehicle, M components. . and M_{tr}. M_{FCD}. (3) subject area Bvehicle. For subject areas of the technical condition of Vehicle we distinguish the following types of relations between sets {F, H, P, O, V, R} within the main subject area of the vehicle monitoring system, tachograph, tracker and FCD in the technical condition system of Vehicle and summarize them in the table . The formulas are presented in General:

$$\begin{gathered}
F_{vehicle} H_{vehicle} = \left\| f_{vehicle} h_{vehicle_{ij}} \right\|; \qquad F_{vehicle} P_{vehicle} = \left\| f_{vehicle} p_{vehicle_{ik}} \right\|; \\
F_{vehicle} O_{vehicle} = \left\| f_{vehicle} o_{vehicle_{im}} \right\|; \\
F_{vehicle} V_{vehicle} == \left\| f_{vehicle} v_{vehicle_{il}} \right\|; \qquad H_{vehicle} P_{vehicle} == \left\| h_{vehicle} p_{vehicle_{jk}} \right\|; \\
H_{vehicle} O_{vehicle} = \left\| h_{vehicle} o_{vehicle_{jm}} \right\|; \\
H_{vehicle} V_{vehicle} = \left\| h_{vehicle} v_{vehicle_{jl}} \right\|; \ O_{vehicle} V_{vehicle} = \left\| o_{vehicle} v_{vehicle_{ml}} \right\|.
\end{gathered} \qquad (4)$$

By analogy, we distinguish the types of relations for the subject area of the tachograph, tracker and FCD in the system of technical condition of the vehicle.

We form an analytical description of the semantics of the system using Boolean adjacency matrices, which describe the corresponding relationship $R_{vehicle}$ between the components of the Mvehicle subject area, based on the following considerations: if there is a relationship between the relevant components - the elements of these matrices are 1 lack of interconnection) - is equal to 0. We define sets of relations (interrelations) between

Mvehicle components within the information model of subject area of the vehicle.

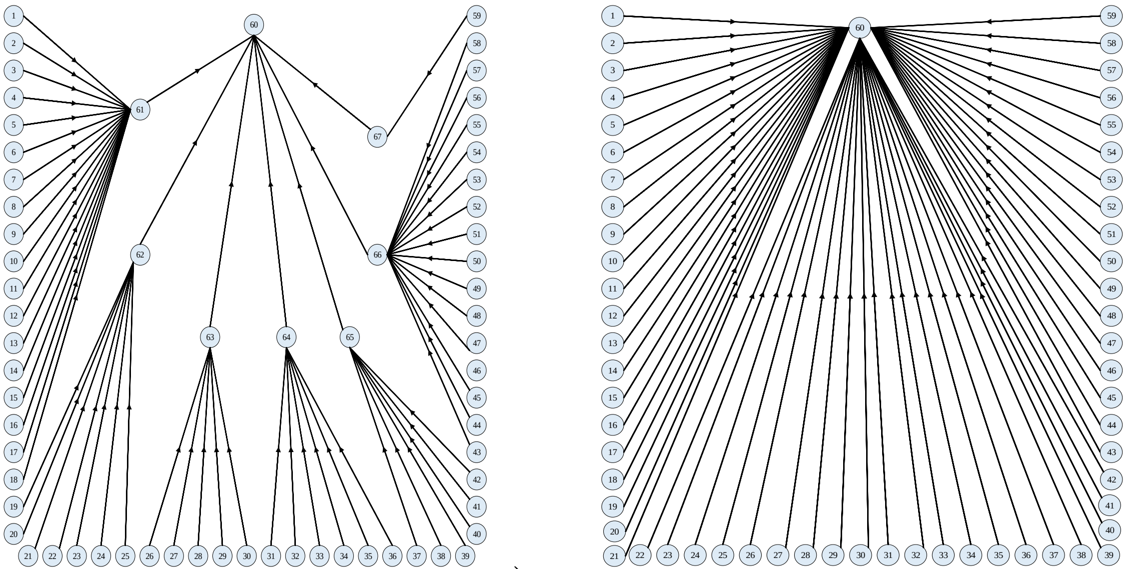
For the subject area of the information system of operative control of parameters of technical condition of vehicle the existing general information element for all information groups was defined. This element "Information collection time" - dveicle60, dtg94, dtr132, dFCD159, which are key due to the semantic dependence of the obtained data of monitoring the parameters of the technical condition of the vehicle from the time of information collection [5-7] . Thus, taking into account the peculiarities of construction, the developed information system for monitoring the parameters of the technical condition of the vehicle has many keys:

$$W_{1.1} = \{d_{60}\}, W_{2.1} = \{d_{94}\}, W_{3.1} = \{d_{132}\}, W_{4.1} = \{d_{174}\} \quad (5)$$

and, accordingly, a set of attributes of the vehicle condition monitoring system, with the tachograph, tracker and FCD control installed:

$$W_{1.2} = \left\{\frac{d_i}{i} = 1, \dots, 59\right\}, W_{2.2} = \{d_i/i = 80, \dots, 93\}, W_{3.2} = \{d_i/i = 120, \dots, 131\}, W_{4.2} = \{d_i/i = 151, \dots, 158\} \quad (6)$$

A relational model of the monitoring system is constructed on the basis of the canonical structure of the database, according to the set of admissible values of the main parameters of the technical condition of the vehicle. Pictures 1 and 2 show orggraphs of the system of operational control of parameters of technical condition of vehicle and general - G canonical structure of model of system of monitoring of parameters of technical condition of vehicle. Thus the information received as a result of the analysis in the components of the ICC [8].



a) b)

Pic. 1. Organizers of the system of operational control of parameters of technical condition of the vehicle a) orggraf G information structure of the system model; b) orggraph G of the canonical structure of the system model

The paper solves an important scientific and practical problem of improving the efficiency of technical operation of vehicles by improving the methods of operational control of the technical condition of the vehicle when changing modes of operation and rest and physical condition of drivers in operation by developing and applying information and analytical system of remote monitoring. The results of the research allowed to formulate the main theoretical and scientific-practical conclusions:

- The technique of construction and research of models of control and management of a technical condition and operating modes of the vehicle in the conditions of operation by means of which it is possible to carry out remote operative monitoring of a technical condition of vehicle is substantiated and offered.

- The information-analytical model of the subject area of the information system of operative control of a technical condition of the vehicle in the conditions of operation is developed. The features of the subject area of the information system using the DFD-diagram are described. created a structured information model of the ICC, which actually provides the information system of operational control of the technical condition of the vehicle in operation.

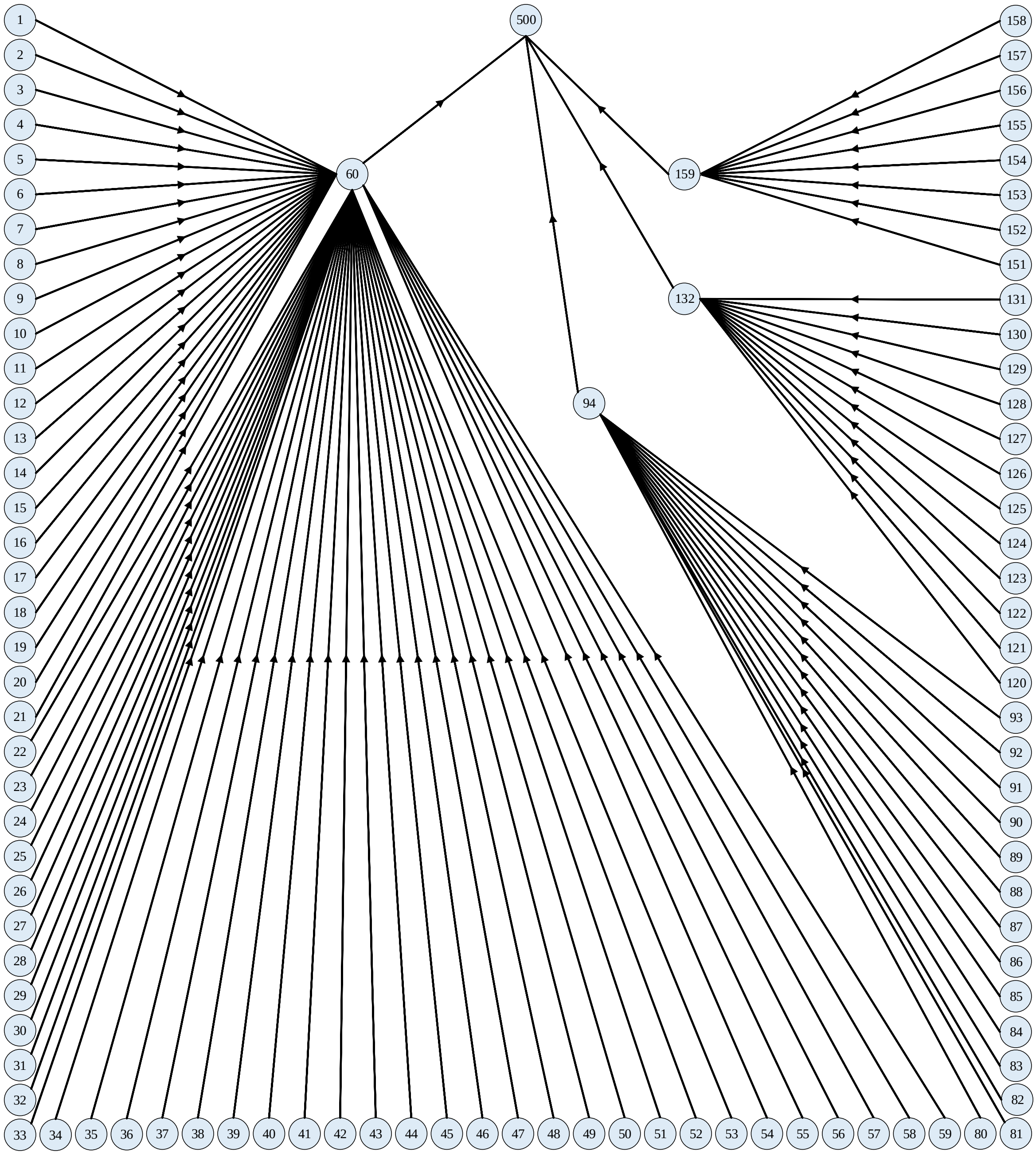


Figure 2 - General spelling G of the canonical structure of the model of the vehicle condition monitoring system

- Formed graphs of information structural elements of the model of operational control of the technical condition of the vehicle in operation, which allow to determine the set of information elements of monitoring subsystems consisting of: technical condition of the engine and vehicle - 59 elements, many elements of the group consisting of 7 elements; modes of work and rest of the driver - 14 elements, a set of elements of group as a part of 5 elements; additional parameters of the state of the vehicle, trailer, environmental indicators vehicle - 12 elements, many elements of the group consisting of 2 elements and the physical state of the driver - 8 elements, many elements of the group consisting of 2 elements, the existing common information element for all information groups - "Information collection time », Which is key due to the semantic dependence of the obtained data of monitoring the parameters of the technical condition of the vehicle from the time of information collection.

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