Formation of Rational System of Maintenance Service and Repair of Cars

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Abstract: In operation, there is an infringement of adjustment systems, assemblies, change the values of the parameters characterizing the serviceability of the car. Among the main factors that determine the effectiveness of the operation of automobiles, the leading place belongs to the system of maintenance and repair of its scientific validity and excellence is now defined as the rules of technical regulation of maintenance and repair. Of great importance in the development of maintenance and repair is diagnosing vehicles. The analysis of the impact of specific malfunctions of cars on their performance indicators and analysis in the field of diagnostics, maintenance and repair has shown the need to develop effective methods for troubleshooting, group operations and to determine the frequency of the mobile sound equipment. The instruments used in the study were the basic provisions of the system analysis, methods of expert evaluation, statistical analysis and logical troubleshooting. Significant scientific results is the development of the theory of probability and logic of the proposed method of troubleshooting and dynamic system of maintenance and current repairs of cars based on it which increases the effectiveness of the technical operation of cars and the total unit costs are reduced by 23.1%.

Key words: Grouping operations, rational frequency, morphological analysis, probabilistic and logical model, dynamic system, field

INTRODUCTION

Among the main factors that determine the effectiveness of the operation of automobiles, the leading place belongs to the system of maintenance and repair, its scientific validity and excellence are now determined by the rules of technical regulation (Rey, 1983; Newman, 1966). Of great importance in the development of maintenance and repair has the diagnosis of vehicles.

At present, widely used system of diagnosing a stationary instrument systems, portable and embedded diagnostics (Verbruggen et al., 1995; Ulikyan and Ohanyan, 2015). However, the use of the built-in diagnostics increases the average cost of cars using the computer control system of the engine 2-5%. Existing methods and based on them instrumentation systems have considerable complexity in the implementation of diagnosing the mobile equipment, high cost and complexity, so not Accessible Transport Companies (ATC), low power (Tsang, 2002; Weinberg et al., 2011; Smith, 2012).

The complexity of troubleshooting determines the need for the practice of operating heavy-set methods and diagnostics tools. The use of existing means of diagnosing of lorries built economically impractical because of the high cost of diagnostic equipment (Chowanietz, 1995; Denton, 2000). For a comprehensive diagnosis of cars on the small and medium ATCa and convoys operating in isolation from the production bases that an effective troubleshooting methods that are very promising with regard to the implementation of the mass is in the means of the external and built in diagnostics.

A comprehensive solution to the problem is possible if you create new methods of troubleshooting to make changes to the existing system of M and R cars aimed at the full use of resources and reduce the probability of failure of the elements of the car.

In view of the above, it is the current development and research of methods and models for assessing the technical condition of vehicles and deducing the optimal frequency of preventive elements of the car. The analysis of the impact of specific malfunctions of cars on their performance indicators and analysis in the field of diagnostics, maintenance and repair has shown the need to develop effective methods for troubleshooting, group

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operations and to determine the frequency of the mobile sound technology which confirms the relevance of the issue.

Comparative analysis of existing methods of troubleshooting has shown that they are complex, high complexity, require complex and expensive equipment and skilled operators. For this reason, they should be used in the sophisticated diagnostic system designed in high power motor companies. Therefore, to address the issues of diagnosing of lorries at the enterprises of small and medium power as well as convoys working in isolation from the production bases, the desirability of developing a simple and effective model of troubleshooting perspective in relation to the mass implementation (ISO, 2011, 2013).

When the car most of the faults shown in the form of external signs. Often the outward signs of manifestation of various faults are the same character (Shumilin and Kulakov, 2015; Koscher *et al.*, 2010). Knowing the most common faults and symptoms, detect the malfunction without spending unnecessary tests and shootouts.

To quickly and correctly diagnose when testing complex object using individual diagnostics tools, you need to have more data on the functional relationships between possible faults and their symptoms as well as have sufficient experience.

Morphological analysis of the best known methods of troubleshooting (exceptions, temporary, probabilistic, logical and value) shows that by combining the methods and sequence of interactions on the scanned object is an increase in the probability of failure detection. Based on the analysis of the most effective is "probabilistic-logical" method of troubleshooting.

The proposed methods and techniques developed on its basis, involves the installation of the vehicle diagnosis system built for the elements most frequently breaking down. For the car is the most complex element the engine and transmission components. If the technical condition of these elements within the acceptable parameters, then using the logic unit operations and diagnose possible to detect almost any problem (Chowanietz, 1995).

The basis of the system of maintenance of vehicles are its structure and specifications. The structure of the system of maintenance and repair affect the reliability and quality of vehicles, goals that are faced by road transport and technical maintenance of cars, operating conditions, available resources, organizational and technical limitations.

The main factors determining the efficiency of the service and repair are some lists (what to do) and frequency (when done) preventive operations as well as

the number of species then their multiplicity (how to organize the execution of preventive operations combined).

There are six methods of group operations: the backbone of operations, natural, feasibility, economic and probability, statistical tests, dynamic. Analysis methods of grouping maintenance operations indicates that by combining the methods and sequence of interactions at the service object is an increase in the probability of operations closer to rational periodicities.

In appointing the optimal periodicity you can use individual or group approach. Individual approach is applied in determining the most critical service frequency components, assemblies and mechanisms of the vehicle and in those cases where the aggregate node or mechanism exposed substantially only one damaged.

There are six methods for determining the frequency of inspection: the permissible level of reliability, the permissible value of the parameter, feasibility, economic and probability, statistical tests, dynamic.

The analysis methods for determining the frequency of maintenance shows that by combining the methods and sequence of interactions at the service object is an increase in the probability of maintenance of species with closer to optimal periodicities.

The basis for such an individual version of the system will be: improving the reliability of vehicles and the corresponding increase. Periodicity; control of the age structure of the park, improving the system of accounting and analysis of reliability, costs, revenues and expenses in the operation of motor vehicles; built in system of accounting work and diagnosing of a technical condition of the car.

The analysis offers a number of methods and tools to evaluate the technical condition during operation and maintenance.

The aim of the study is to improve the technical operation of vehicles on the basis of effective methods, models and tools for troubleshooting vehicles.

Objectives of the study:
- Analysis of ways to improve existing methods for determining the sound frequency of the car
- Development of effective methods, models and tools for troubleshooting car
- Development of existing and development of new methods and models of group operations and to determine the frequency of execution then during operation of cars
- Development of methods, models and techniques of research indicators for the technical condition of vehicles in the process of diagnosis for maintenance and repair of motor vehicles

- Development of a model of the automated evaluation of the technical condition of cars
- Development of models of automated control of a technical condition taking into account its assessment under the program-oriented approach
- The practical implementation and introduction of the results and their evaluation

MATERIALS AND METHODS

Experimental studies were conducted to collect data for the formation of a model of operational reliability as well as practical testing of theoretical procedure described in the second chapter. For this experiment was carried out at the various enterprises of road transport.

In accordance with this method on the first stage selection and justification of the research facilities, the choice of test plans and determining the volume of statistical observations.

At the second stage analysis of the organization of the enterprises in which the experiment was conducted, their document management, accounting systems and information systems. For experimental studies in the enterprise should be streamlined workflow that allows you to get reliable information on failures and malfunctions, perform works and repair of their time consuming. Production and technical base of the enterprise on which the experiment is conducted, equipment manufacturing equipment and tools, regulatory and technological support should provide quality and timely execution and repair of the test object.

In the third stage, based on theoretical studies determined the qualitative composition of the necessary information to be obtained during the passive experiment. The composition of the following information: quantitative characteristics of reliability of elements of objectsperformance testing, quantitative characteristics of the object elements maintainability performance tests, data on the cost of the structural elements of performance testing facilities, expertise on the formation of faults and malfunctions, the relationship of the structural elements and objects of operational tests.

Information system techniques of experimental research to unify the system of information security, acting on the undertakings in which the experiment was conducted. Passive experiment is to obtain information on the reliability and maintainability of KAMAZ vehicles.

The existing road transport system for collecting and processing information on the operational reliability of the system is based on state standards. There are a number of reference documents that reflect the stages of creating a controlled sample of vehicles, their volumes,

their requirements, etc. These documents served as the basis for the development of operational methodology of the experiment.

The whole operation of KAMAZ vehicles occasion in accordance with the "operating instructions" and "Regulations on the maintenance and repair of vehicles". Maintenance was carried out in full. Replacing the oil is produced regularly.

RESULTS AND DISCUSSION

All electronic components in functions can be classified into three main control systems: engine, transmission and chassis, salon equipment (Chowanietz, 1995).

At the present time in the world developed and is commercially available a wide variety of engine management systems. These system actions have much in common but also differ significantly. On purpose they are mono-functional and complex. In complex systems one electronic unit controls several subsystems: fuel injection, ignition, valve timing, diagnostics, etc. In mono-functional systems, the ECU sends signals only to the injection system. Distribution of fuel and distinguish between central multi-point injection. When you installed multipoint injection one injector per cylinder and if there is one central atomizer for all cylinders.

Furthermore, the difference lies in the injection method. The injection can be carried out continuously and by pulses. With a constant fuel supply amount is changed by changing the pressure in the fuel line when pulsed by the pulse duration and its frequency. So, one injection can be served the full portion of the fuel or a portion (usually half). If for every revolution of the crankshaft is one injection of fuel into each cylinder, the injection is called synchronous.

In the electronic transmission control system controlled system is mainly automatic transmission. On the basis of signals from sensors of the angle of throttle opening and vehicle speed, the ECU selects the optimal gear ratio of the transmission and the clutch. Electronic transmission control system in comparison with past hydro-mechanical system increases the accuracy of the transmission ratio, simplifies the control mechanism, increases the efficiency and manageability.

The chassis management includes the management of processes of motion, change of direction and braking of the car. They affect the suspension, steering and brake system to maintain a given speed. Management of salon equipment designed to increase the comfort and value of the car. This is used for air conditioner, electronic instrument panel, multifunctional information panel, compass, lights, wiper intermittent control, indicator lamps

burned out, the device of detection of obstacles when reversing, anti-theft device, communication equipment, central door lock, power windows, seats with adjustable, security, etc.

Most modern cars are equipped with enough sensors to track technical condition of the car from which the signals are fed to the Electronic Control Unit (ECU). To read information from the ECU diagnostic connector is provided. Currently, the most widespread is the OBD-II interface. But the data from the ECU must be decoded using special adapters and software content.

For KAMAZ-4308 used Board Computer (BC) through the ECU (ECM Cummins). The work of Cummins ECM is designed to control the Cummins inline 6 adapter and Cummins Insite 7.5 Software (these versions are currently the most popular). But the cost of this kit in Russia is about 80,000 rubles. In addition to engine management, the ECU receives signals from all of the major components and assemblies.

BC allows you to display various parameters: travel time, time in motion, the path traveled, total fuel consumption, the fuel consumption at idle speed, current speed and a wide range of values, calculated on their basis (average path, average speed, etc.). Diagnostic scanner has the following features:

- Protocol OBD-2
- Read fault codes
- Delete fault codes
- Output parameters real-time
- Conclusion of internal testing of the diagnosis system
- Reading of the VIN
- Advanced features (depend on software)
- The firmware version of the microcontroller ELM: 1.4

A list of controlled scanner parameters nodes: the battery, anti-lock braking system, audio system, gas discharge lamp, alternator, power steering, steering angle sensor, steering wheel, doors, engine, mirrors, immobilizer, climate control, wheels, air conditioning, cruise control, body, GPS on Vivacia, parking sensors, air suspension, airbags, dashboard, radio, handbrake, interior, seats, TV, brake system, transmission, traction and central locking.

The driver receives information about the mode of movement and technical condition of the car with the help of measuring and control devices and indicators placed on the dashboard. The instrument panel of a modern motor car contains from 3-6 switches devices and 5-7 LEDs, placing are based on the following principles:

- Grouping in the center of the panel displays information related to road safety
- Placement of instruments and indicators the closer to the center of the panel, the higher the frequency of the reference driver
- Grouped into a single block of functionally related devices and indicators

Development and implementation in automotive electronics have enabled engineers and designers to create an electronic instrument panel in which instead of the usual electro-mechanical devices installed electronic information devices and indicators. Electronic indicators, in addition to the functions performed by Electromechanical devices, capable of providing the driver with information in digital, graphic and textual forms. With the help of electronic devices possible the synthesis of human speech, the indication of the indicators to determine which require complex calculations, the analysis of whether the transfer of information to the driver.

Electromechanical devices, typically designed to display only one parameter because when using multiple scales deteriorates the ability to read with their evidence. In addition, they have considerable overall dimensions which makes difficult their placement on the dashboard. Digital indicators at smaller sizes can inform about the values of several parameters to convey a variety of messages and therefore, allow us to greatly increase the informativeness of the panel with the same dimensions.

It should also be noted that the electronic information device provides the driver with more reliable data. This is due to the increased accuracy of the devices or digital representation of the information.

When using car instruments and displays are always there is the following problem: on the one hand the driver should rarely have to look away from the road for safety, the other hand if the instruments not to watch, you can ignore the warning about low oil pressure, etc. There are ways to solve this problem such as audible signals, the location of the devices is always in sight but the most advanced method today is considered displaying information on the windshield (Head Up Display or HUD). Initially this technology was used in aviation when designers are faced with the need to accommodate up to 100 warning indicators in the cockpit of a fighter. The image from the projector (cathode ray tube, liquid crystal matrix) projected on the windshield which after processing, the semitransparent mirror. The driver sees the road through this glass is the mirror when the projector is on and off. The image brightness automatically adjusts to outside lighting (Weinbtrg *et al.*, 2011; Smith, 2012).

What information and when displayed on the windshield on board computer decides depending on the situation. For example, the speedometer makes sense to project permanently and the indicator lamp oil pressure in the engine, only if it (the pressure) is decreased to a critical level. Advanced system HUD display information directly in front of the driver. As displays warning information are also used LCD rearview mirror automatically changes reflectance when illuminated them in the dark with headlights coming from behind cars.

General motors has released a system for facilitating the driver to orienteering on the basis of HUD and the speech synthesizer. The voice synthesizer outputs a prompt of the type "turn left at the next intersection" and on the windshield schematically represented this part of the road with a pointing arrow. The system may also issue warnings like, "turn 0.3 m" or "road work ahead". In this she is no different from similar projects of other companies but the use of the HUD makes it more comfortable. Developed methods, allowing to determine where it is sent to the driver's view at any time and to project the necessary information with the HUD at this point on the windshield. The method involves the use of portable video cameras and laser. The laser beam is reflected from the cornea of the driver, allowing you to pinpoint exactly where the driver is looking. Probably motion detection view can also be used to determine the condition of the driver. Then, any anomalies detected will sound an alarm (audible or visual).

With the ongoing computerization of automotive systems more and more functions become available. Today there is the ability to control the flow of information to the driver, i.e., on the same display to display various information needed by the driver at this time. What information is needed in this situation to the driver, determines the computer software. For example, if the display displays a distance that can pass the car with the existing fuel, there is no need to show amount of fuel in the tank, etc. However, the driver can cause the desired blocks of data to the display and independently. For example, if the coolant temperature is normal, no need to take readings on the display but on request driver possible. In addition, the computer can interrupt the normal process output information and to generate on the display a warning message of type: "fuel consumption was only 50 km or decreased pressure in the left rear tyre". The use of software speech synthesizers allows such messages by voice and the driver in system configuration can set the desired voice options: male or female, high or low, etc. To attract the attention of the driver used and more blips (Chudaykina and Kravchenko, 2014).

A holographic image is a three dimensional representation of a real object it uses laser emitters projector and suitable screen. In currently ongoing research and development of equipment to increase the safety of riding in the dark. One of the options is as follows: information is removed from the infrared cameras is processed, the holographic image is projected onto the windshield in front of the driver. Through the use of this kind of night vision driving in the dark easier.

However, the electronics in the car not only helps, but sometimes hinders. Research conducted in the group of drivers age category over 60 years of age, showed that the use of electronic card distracting the driver from the road. The reaction of the elderly driver who while driving is forced to be distracted by telematics is reduced by 30-100% in comparison with its 18-30 years old peers.

As expected, the conducted research allows to select the optimal mode of use of telematics devices. It will be useful not only for elderly but for young drivers that in case of difficult traffic situation should quickly understand all the signals given by the computer and correctly to react.

For a modern car is most expedient system with two or three kinds of maintenance since such a structure of the unit cost of maintenance and repair of Chet organizational minimal.

This is confirmed by long experience of road transport in Russia and other countries. In Russia, the most common is now a three-tier system M-maintenance: EM-everyday maintenance, M-1 and M-2 (which can be combined SS-Seasonal service). In the United States, according to a survey on the organization of the best engineering services companies, three-tier system (A, B and C) used 60% of freight and 50% of bus companies, two-stage and 23 -20%, a 4-15 and 18%, multistage -5 and 9% ATC.

For enterprises with poorly organized maintenance (failure to list non-compliance periodicity) as a first step to remedy the situation can be recommended for single-stage system maintenance, followed by the transition to a two or three steps.

Reduction of organizational and administrative costs of the system (taking into account the use of a PC and the planning, preparation, etc.). Makes it possible to increase the number of economic criteria kinds of a car, that is closer to the optimal periodicity of some individual operations.

In the first term, for heavy-duty trucks and large buses and then for the majority of commercial vehicles can be implemented individual systems and standards and repair of individual vehicles or groups working in similar conditions. The basis for such an individual version of the system will be:

- Increase the reliability of vehicles and the corresponding increase periodicity
- Monitoring the age structure of the park
- Improving the system machinery accounting and analysis of reliability, costs, revenues and expenses
- On-board system of accounting research and diagnosis of the technical state of the car

The theoretical study of methods of troubleshooting, group operations and to determine the frequency of the car is shown that to determine the best practices for troubleshooting cars, groups of operations and to determine the frequency of administration it is necessary to consider the probability characteristics. The most adequate description of the facility maintenance and thus a tool for tracking faults and timely elimination of failures provided the use of rational coefficients:

$$K_{ri} = \frac{P_{pi}}{P_{ei}} \rightarrow min \qquad (1)$$

Where:

P_{pi} = The Proposed method of setting troubleshooting group operations and determining the frequency of the car is (complex index)

P_{ei} = Parameter existing method troubleshooting, group operations and to determine the frequency of the car is (complex index)

Analysis of the components of this factor leads to the conclusion that the lower rational ratio, the effectiveness of the proposed method of troubleshooting, group operations and to determine the frequency of the car.

An important consideration in determining the most effective model of troubleshooting, group operations and to determine the frequency of the car is a component of the costs of the maintenance and repair. To determine the impact of the cost factor in the overall cost of the method may be written as:

$$K_{ci} = \frac{C_i}{\sum C_i} \rightarrow min \qquad (2)$$

Where:

C_i = The Cost of one of the methods of formation of maintenance and repair

$\sum C_i$ = The total Costs for all methods of formation of maintenance and repair

The higher costs are one of the methods of formation of maintenance and repair and thus the ratio of the cost, the less economical service the car.

In the future, first for large trucks and large buses and then for the majority of commercial vehicles can be implemented individual systems and standards for the maintenance and repair of individual vehicles or groups working in similar conditions.

The aim of the pilot study was to identify the weakest elements of the car, the definition of their average share in the operation and the degree of influence on the performance, the development of measures to detect and failures during operation.

Analysis the distribution oftime to failure of the engine and transmission indicates that it can be described by a normal distribution (Fig. 1 and 2).

To determine the effectiveness of the use of a dynamic system. The distribution oftime to failure of the are the most significant unit Cost of repair C_p, rub./1000 km. Results of the analysis of specific repair costs depending on the method of diagnosis are presented in Fig. 3.

These valuescan be used for planning the repair costs, in the analysis of small ATC, with the predominant prevalence of KAMAZ vehicles. For example, one KAMAZ to repair the engine and transmission, on average spent 6369.30 rub., 80% of the repair costs of no more than 6, 908.23 rub.
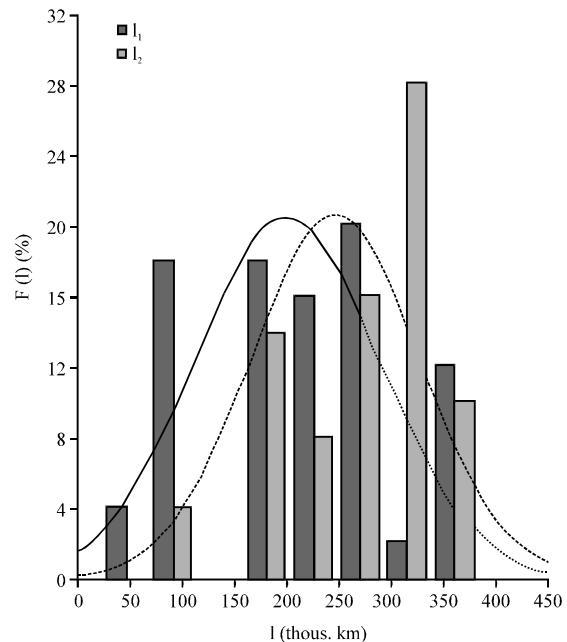

Fig. 1: The distribution oftime to failure of the engine dependingon the choice ofmaintenance and repair; 1) For regular preventive system; 2) For the dynamic system maintenance and repair ((l_1 = 50×50×normal (x; 195; 8057; 98, 1994); l_2 = 46×50× normal (x; 248 5498; 89,7192)
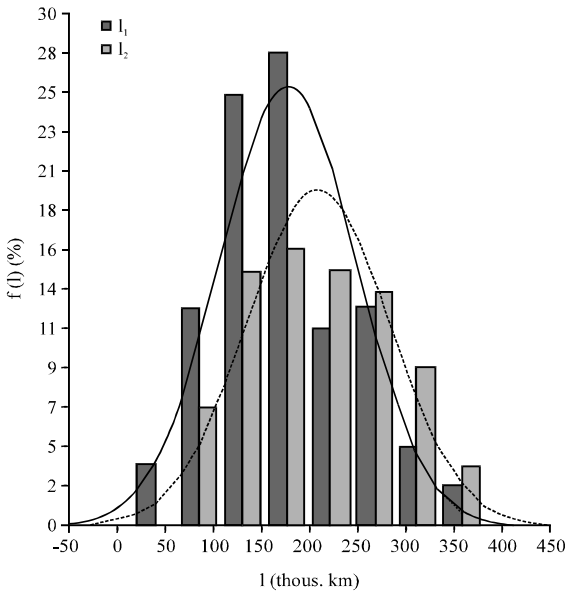
Fig. 2: The distribution oftime between failures transmission, depending on the choice ofmaintenance and repair; 1) For regular preventive system; 2) For the dynamic system (l_1 = 87×50×normal (x; 175,5337; 77,6319); l_2 = 69×50×normal (x; 210.1699; 80,6997)
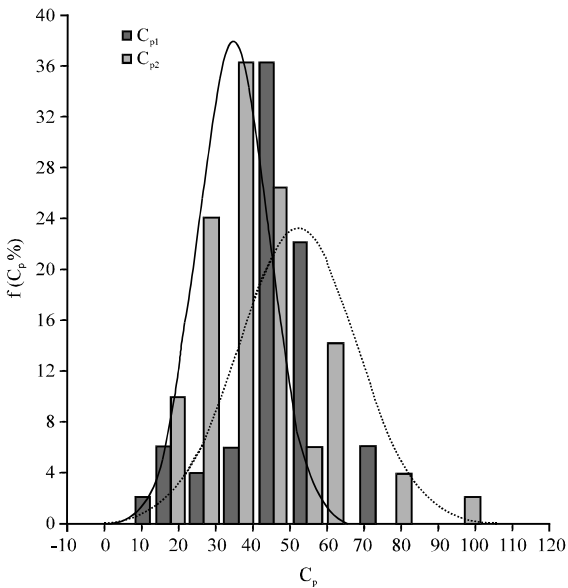

Fig. 3: Distribution of average unit costs to repair the company; C_{p1} before introducing dynamic system maintain and repair; C_{p2} after the introduction of a dynamic system of maintenance and repair; Var1 = 50×50×normal (x; 52,0106; 17,2687); Var2 = 50×10×normal (x; 33,192; 103791)
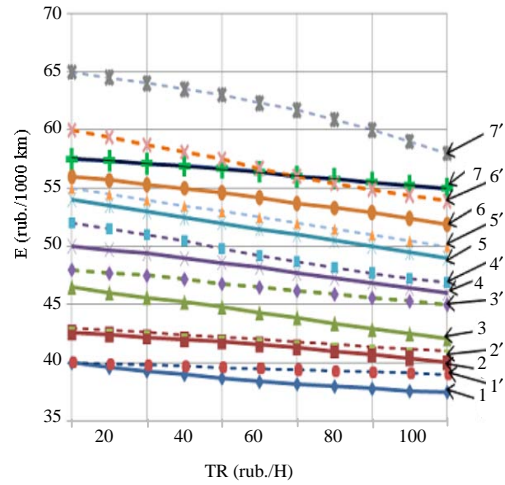

Fig. 4: Graph of efficiency, depending on the strategy and the hourly wage rate TR as well as the cost of 1 h of downtime; C_d: 1, 1'-0; 2, 2'-200; 3, 3'-400; 4, 4'; 600; 5, 5'-800; 6, 6'- 1000; 7,7'- 1200; 1) —: For regular preventive system; ----: For the dynamic system

For the dynamic system of maintenance and repair compared to increased by 17.7% while the total cost per unit decreased by 19.1%.

To predict the loss of KAMAZ vehicles were experimental studies which have resulted in a change in performance of unit costs as well as changes in efficiency, depending on the system maintenance and repair and the hourly tariff rate repair as well as the cost of 1 h of downtime ref (Fig. 4).

The effectiveness of dynamic system maintenance and repair increase with an increase in the cost of one hour of downtime and decreases with the increase of the tariff rate specialist. Application of dynamic system maintenance and repair will reduce the amount of time, regardless of the cost of standard hour.

The obtained dependence indicates that the total cost per unit which are formed during the operation of vehicles KAMAZ dynamic system of maintenance and repair, increases with an increase in the cost of one hour of downtime and time wage rate.

Efficacy dynamic system maintenance and repair higher than prophylactic strategy. The dependence of the efficiency of a single value of the cost of 1 h of downtime varies slightly but the increase in hourly wage rate, substantially increased the losses of the enterprise.

Thus, the effectiveness of preventive strategies by increasing the hourly wage rate is reduced and the efficiency of dynamic system maintenance and repair increases. The basis of the individual variants will serve as a dynamic system:

- Increase the reliability of cars and a corresponding increase in frequency of maintenance and repair
- monitoring the age structure of the park
- Improving the system of accounting and analysis of reliability, costs, revenues and expenses
- On-board system of accounting research and diagnosing of a technical condition of the car

Implementation of these and other technical and organizational measures contributes to increased productivity during the maintenance and repair of rolling stock, provides a reduction in labor and material costs (Chowanietz, 1995). The developed hardware, software and algorithms are part of the system diagnostics, maintenance and repair vehicles.

The developed model sample of the technical diagnosis of the engine consists of three main parts: a set of sensors, interface and software. Technical implementation of the system of technical diagnosis of the car on the basis of the proposed methods may be different, depending on the conditions of use of the system and manufacturing capabilities. However, in principle there are two possibilities of realization of diagnosing different types of computers. This can be a specialized microcomputer integrated with sensors and interface designed as a portable device-motor-tester for diesel engines and transmissions. A second embodiment of the system of technical diagnostics and diesel power train-using personal computers as portable and stationary. Implementation of the system of diagnosis based on the proposed methods will reduce the cost of maintenance and repair of vehicles as well as improve the performance of operational reliability of vehicles.

The most applicable system of maintenance and repair in which will seek to minimize the costs of maintenance and repair. Such a system it will be more dynamic. The proposed systems servicing and maintenance on the basis of the built-in diagnostics to determine the optimal time of the vehicles for service or maintenance, consolidate operations maintenance and repair groups; determine the complexity of repair and maintenance research, the number of posts to facilitate operational planning and management and maintenance and repair cars, increase the level of operational reliability of the vehicle fleet, reduce material and labor costs of maintenance and repair of motor vehicles apart from the production base.

CONCLUSION

The theoretical-methodological concept of assessing the technical condition of vehicles on the basis of probabilistic-logical method established by the analysis of troubleshooting techniques.

The scientific bases and system maintenance and maintenance on the basis of the built-in diagnostics with the use of software and information complex which allows to determine the time of setting the car for servicing or maintenance, consolidate operations maintenance and repair groups to determine the complexity of repair and maintenance research that improves the quality of operational planning and management and TS cars, the level of operational reliability of the vehicle fleet, reduce material and labor costs of maintenance and repair of vehicles.

The concept of maintenance and repair of motor vehicles on the basis of probabilistic-logical model of troubleshooting and analysis methods for grouping operations and determining the frequency of the car is. Developed and tested probabilistic-logical method of troubleshooting car, providing selection of the most effective system of maintenance and maintenance of motor vehicles enterprise.

Develop a methodology and scientific and methodical approach, using methods proposed grouping of operations and determine the optimal frequency of MOT in the operation of vehicles, makes better use of the resource cars.

Develop a methodology and scientific and methodical approach using the proposed probabilistic-logical method of troubleshooting and dynamic system of maintenance and maintenance of vehicles.

The theoretical position and a set of advanced scientific and methodological support of the planning, organization and management of maintenance and repair of motor vehicles which will increase the efficiency of operation of vehicles and ensure economic effect of 27438 rub. per year per vehicle.

The proposed theoretical and methodological principles and scientific and methodological support contribute to the operational reliability of the scientific basis for enhancing the operational efficiency of cars by preventing and reducing the number of failures and improve the processes of maintenance and repair for a dynamic system maintenance and repair increased by 16.7%.

Significant scientific results is the development of the theory of probability and logic of the proposed method of troubleshooting and dynamic system of maintenance and current repairs of cars based on it which increases the effectiveness of the technical operation of cars and the total unit costs are reduced by 23.1%.

Develop programs and software modules for embedded system diagnostics and trucking companies will improve the handling process, enable timely maintenance and repair of motor vehicles, reduce downtime by 19.7% of the power supply system of the engine and 18.7% of the gearbox.

The set of new results and findings, developed mathematical models and the concept of improving the reliability of cars in the technical operation helped to create a science-based theoretical and practical tools that has been tested for: the system improve the technical condition of vehicles and improve the quality of transport service users, reduce costs maintenance and repair. The reliability and usefulness of the results confirmed 12 references to implement educational and industrial organizations.

Perspective is expected the development of research in the field of use of the developed theoretical positions and scientific methods have a universal character to address the important issues of improving the system of maintenance and repair of cars with petrol engines and the use of the proposed methods in the various sectors of the economy as well as search and testing of new methods.

Consistent specialty 05.22.10 "Operation of motor transport" (the Regularities of changes of technical condition of cars and units of technological equipment to improve systems maintenance and repair, determine the standards of technical operation, rational life of the car).

The main research results are reported, discussed and approved at the 9th all-Russian scientific-technical conference "problems of quality and operation of vehicles", the 7th international scientific and practical conference "Perspective directions of development of transport complex", international scientific-practical conference "Problems and prospects of development of motor transport", 5 international scientific forums "Science of young-intellectual potential of the 21st century", international scientific-practical conference "problems of development of transport complex" international scientific-practical conference "problems of development of transport complex" international scientific-practical conference "Problems and prospects of development of road transport", International Scientific and Practical Conference "Innovation is the source of development of national economy-2014" 10th International scientific-th conference "Science and innovation 2014-2015" (Przemyœl, Poland-2014-2015) 10th International Scientific and Practical Conference "Scientific horizons", Sheffield, England the 2014-2015, "the Real research and development" Sofia, Bulgaria, 2015, 3rd International Scientific Conference, Chicago, 2014.

The research results, the basic theoretical principles, research and practical results, mathematical models and methods of troubleshooting used in the design and implementation of research works "Development of probabilistic and logical method of troubleshooting" under the Contract No. 14.58 from 17 February 2014 "Development of embedded system for diagnosing diesel engines" under the Contract No. 15.58 on January 25, 2015.

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