ROLE OF SITUATION CENTRE IN SERVICE MAINTENANCE OF TRACTION ROLLING STOCK

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ABSTRACT

As a form and means of maintenance, this system of service is designed to support service life of rolling stock. Service maintenance in the article is analyzed within the framework of locomotive lifecycle management and on the basis of reliably organized information network. As a decision-making headquarters, the authors consider situation center in which each of action elements has its functions and is evaluated in conjunction with objectives and tasks to improve efficiency of maintenance and repair of rolling stock (equipment of locomotive depot).

Keywords: railway, locomotive, service maintenance, situation center, maintenance, repair organization, information systems.

Background. *Service maintenance is considered to be the most promising system of maintenance operations (hereinafter – MO), as it allows supporting the working life of the locomotive with enough flexibility. Effectiveness of the system is increased by the use of methods for life cycle management (LC).*

Lifecycle management is a multi-objective problem, aimed at provision of operational efficiency, availability, reliability, minimization of failures and equipment downtime. Prospective methods are possible if there is accurate and complete statistical information on operation, service and maintenance, and here analytical approach to information requires construction of system for storage and processing of data, which will be suitable to this complex problem.

Objective. *The objective of the authors is to investigate role of situation centers in the system of service maintenance regarding traction rolling stock.*

Methods. *The authors use analysis, comparative method, evaluation approach.*

Results.

Decision-making headquarters

Creation of data processing centers at enterprises, which deal with locomotive maintenance, has its reasons: a small price to implementation of the system, no need for communication channel, possibility of upgrading existing structures for unique needs, high speed of decision-making, etc. In such circumstances, reliability of the system increases at the stage of end user (in case of technical failure information system of only one company stops functioning, while others work in full). However, the biggest challenge may be competence of personnel taking decisions on the basis of received data, since it is often not possible to involve third-party experts to solution of the problem. A common situation is where depot is not able to have highly skilled professionals who can deal with technologies and assessment of the scope of vehicle repairs.

In the current system of accounting and analysis of data on locomotive fleet there are significant disadvantages, one of them is lack of the latest information about technical condition of the locomotive. The system only collects, stores and analyzes information about technical failure and its apparent reason. For example, failure of axle equipment due to imperfect repair. In the current scheme of gathering information there is no data on technical condition of traction rolling stock (TRS) prior to failure. It turns out that the system only provides a vector, where it is necessary to focus attention, but does not give advice ("interference") to address and to prevent failures. Disadvantages of existing system include also a high percentage of subjective information: human factor is present at failure detection, attempts to hide real technical condition and quality of repair.

In this case, the best option is a centralized system for collecting and processing information when basic enterprises of MO, repair factories act as users of a unified information system (Pic. 1). The user in real time can exchange information with the system, increasing speed and quality of received data. An additional advantage is advancing factor (diffuse effect), possibility of accumulation of significantly more information for further analysis. This increases accuracy and objectivity of the output stream.

With that said, it is advisable to have a situation center (SC) as a head unit in the system of service maintenance. Being brain of the structure, it absorbs all promising developments, used for analysis of information, decision-making algorithms. At the same time it is not only a place of information accumulation, but also the headquarters of decision-making, adjusting and development of technical documentation accompanying the process.

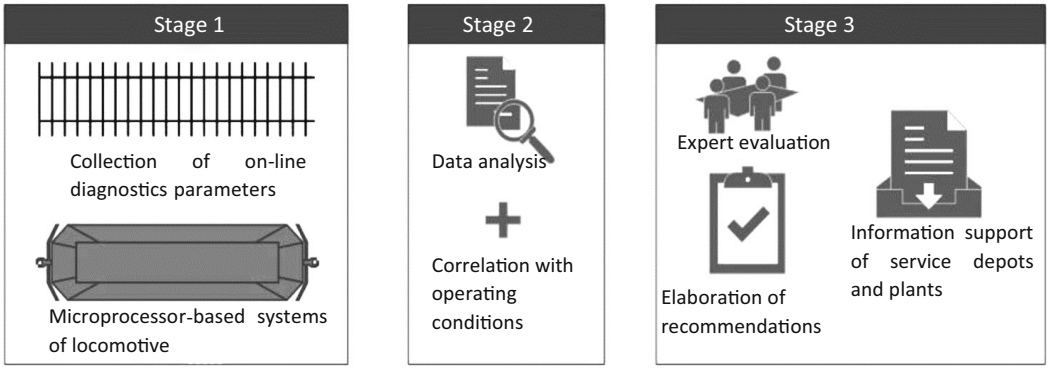
As results of SC activity show, that following actions are received and provided:

- *Interactive presentation of information;*
- *Assessment likelihood of different events by the most qualified experts;*
- *Rapid decision-making;*
- *Ability to simulate effects of management decisions.*

Stage-by-stage approach to the process

SC operation can be divided into three main stages: information gathering, information analysis, decision-making (Pic. 2). These stages are connected to a single information space and are constantly adjusted to maximize data reliability and to improve efficiency of service. SC information space is a set of results of the center's activities, or rather its three components: information resources, communication tools and information infrastructure.

The first stage for SC is information gathering. At this stage data from various sources are accumulated, including from on-board systems, rapid diagnostic systems, technology and technical reports from industrial enterprises. Construction of data collection process can be greatly simplified and the cost can be reduced by using integrative principles. Modern locomotives are increasingly equipped with microprocessor- based self-testing systems, a large number of sensors allow to assess the state of



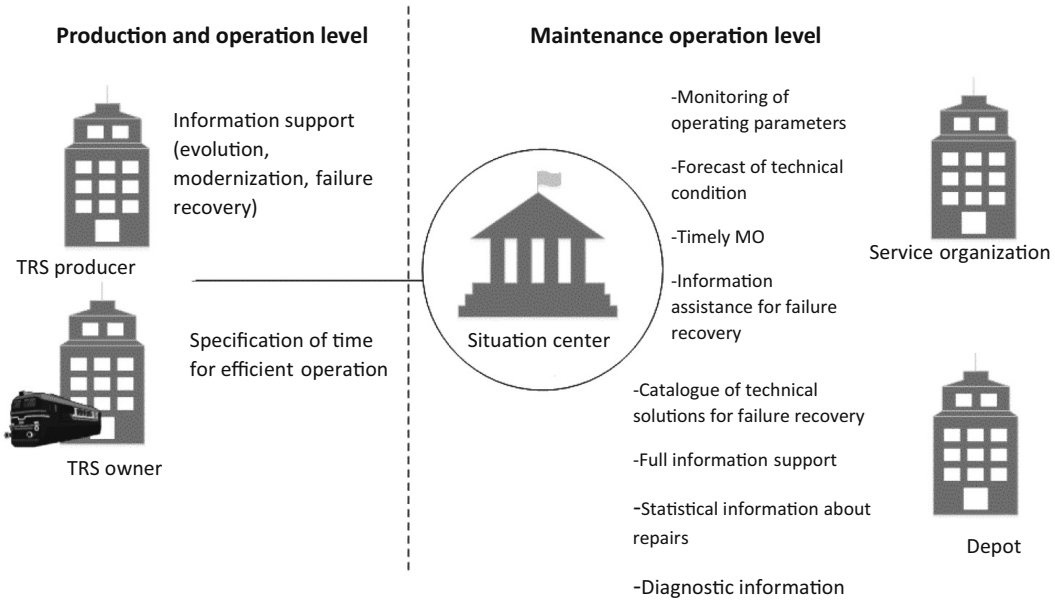
Pic. 1. Synergetic tasks of situation center.

equipment in real-time. However, sensors are devices with their own drawbacks.

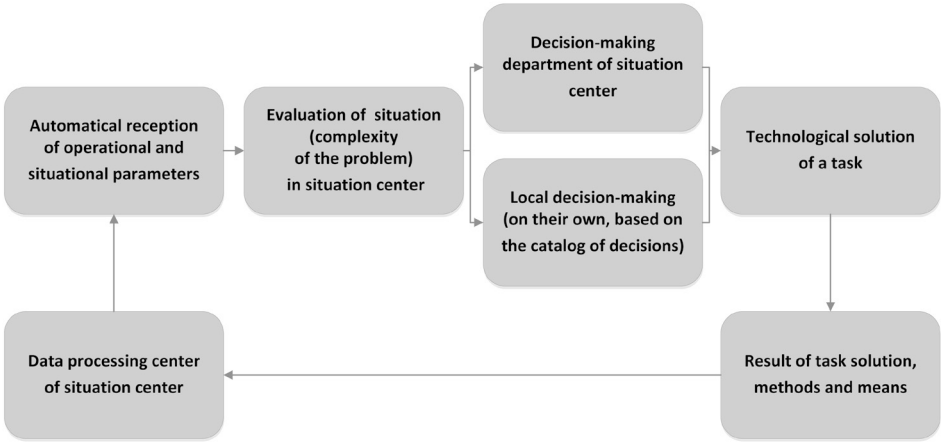
Firstly, the cost of sensors and their installation is rather high, and secondly, devices themselves have a certain service life, and may go wrong. The more sensors are used (units of diagnostic chain), the lower is reliability of the entire system. So such an approach will be correct, in which diagnostic data collection systems are integrated into a unified information-analytical system. For example, having a system of operational diagnostics of axle unit state on the most loaded hauls, we can save on installation of sensors on locomotives, selecting their optimum amount. Furthermore, it is necessary to provide for information reception from diagnostic systems that are located in the depot. Then when a locomotive is accepted for regular maintenance or equipment array of operational parameters will be recorded, automatically identifying an object and transmitting data on it for storage in SC. It is important to ensure that accumulation of information to conduct scheduled and unscheduled repairs, their frequency, technologies used for failure recovery.

The second stage of SC operation is associated with analysis of accumulated data. Mathematical systems and models for assessing reliability, statistical probability are used. Full amount of data is considered, they relate to conditions and geography of operation. It is necessary to create and to continuously maintain up to date information classification system. Classification system is based on the analysis of data importance for trouble-free operation of the locomotive, similarity of structural units, their purpose and enables not only to decide on their timely replacement or repair, but also to predict possible failures, in particular by type of equipment.

The third stage involves decision-making, development of recommendations and information support of base enterprises, providing MO. Particular attention in SC should be given at that moment to the use of instrumental- modeling tools in the preparation and decision-making, concept of information visualization, revitalization of operators and experts, laws of information perception in the course of work on solutions. Moreover, it should be noted that the role of expert staff cannot replace the volume of analytical data. Among other things, information support of SC users is important regarding provision of process with industry standards, maintenance and project documentation in real time.



Pic. 2. Stages of SC operat



Pic. 3. Information flow of decision-making.

Technical and technological aspect

Technical basis of the situational center is data center – a high-performance structure of a sufficient number of server machines, which can satisfy needs of SC in the current collection, safe storage and quick data processing. The fact of receiving input data and their timeliness are the base for further analysis. The information obtained should meet the highest standards of accuracy and be quite relevant. Its usefulness may influence decision-making not only in the case of a single TRS, but model, series, type of machine (Pic. 3).

Technological aspect of SC operation does not become less important in the build-up of information exchange. In the service maintenance system situation center helps to improve both technological preparation of production (especially at the time of admission to the locomotive repair facilities), and technology of the promptest failure recovery. In principle, the new technology is the ability to create a catalogue of decision-making, when each master in preparation for repair is able to see results of similar cases, and to choose the most appropriate technology, followed by the database input of information about speed of failure recovery and methods to track results of repair. Accumulated in such a way «clues» and instructions can be classified and tested in practice by fixing the complexity of repair and locomotive downtime, which in turn makes it possible to clarify the timing of MO, recruitment indicating the demand of qualification and its subsequent reservation. Determination of the cost of operational phase of life cycle of the locomotive as a whole, as well as the design of new repair technologies based on proven practices are possible.

One of the great advantages of SC is a possibility to simplify problems of staff. Receiving detailed information, having all technical documentation, having a channel for consultation with experts, management personnel, who must take decisions, can live quietly. They are not always required to have high qualifications, since the responsibility of a decision-maker is insured with reliability of information, and lack of experience may be adjusted by catalogue of solutions.

Conclusion. *Overall, SC enables to get thanks to high-quality information real, economically viable solutions.*

Creation of situation centers is a progressive way to help organizers of rolling stock repairs. It approximates to the forms of repair by technical state that claim themselves on the basis of transfer of information from on-board computers of locomotives and are increasingly accustomed to the use of satellite, cellular and other wireless data transmission systems.

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