To the concept of improving the quality of technology for the arctic zone of the Russian Federation

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Abstract. The restoration and development of the technological potential of machine-building enterprises to the modern technical level with the existing approaches requires not only significant investment, but also a robust strategy of actions to achieve the targets, the main of which is a comprehensive increase in the quality of manufacturing and increase in the production volume of machine-building products. Only a quick and steady increase in the quality of machinery and equipment, at least to the level of the best world analogues, will ensure the steady and intensive development of the entire machine-technological complex of the country. This is especially true for improving the quality of equipment designed for use in harsh arctic conditions.

Materials and methods. The current level of domestic equipment quality differs significantly from foreign counterparts. The results of organizational and technological studies indicate the need to improve existing forms and methods of organizing production and maintenance by machine manufacturers throughout the entire life cycle. Monographic research, analysis and synthesis, abstract and logical, technical and economic assessments are used as scientific research methods.

Research results. The goal is solving the problem of improving the quality of domestic technology. The proposed organizational and technological solutions provide an accelerated output of mechanical engineering in terms of product quality and production volumes in accordance with the requirements of technological modernization of the country's economy.

Discussion and conclusion. To achieve the required level of quality of technological machines and equipment, authors propose to improve the quality of manufacturing and reliability indicators of machines and equipment. The solution to this problem is the reorganization of the existing production and technological system and the introduction of proprietary engineering and technical service (maintenance) of equipment throughout the entire life cycle.

Introduction

The basis of the socio-economic development of the Arctic zone of the Russian Federation is the effective functioning of military, industrial and social facilities that ensure the defense capability of the northern borders, exploration and production of natural resources, and vital functions of personnel and the population. Harsh Arctic conditions impose special requirements not only on people living and working in these conditions, but also on the means of material and technical support used, forms and methods of organizing labor and production [1–4].
The peculiarities of the Arctic zone development are the presence of significant sparsely populated territories, a low level of technical equipment of production and the social sphere with highly reliable machines and equipment, objects of repair and maintenance base, a shortage of highly qualified technical personnel, limited opportunities for the development of specialization and cooperation in organizing engineering and technical support.

The purpose of organizational and technological research is to comprehensively improve the quality of machinery and equipment to the level of the best world analogues based on the development and implementation of a proprietary production system and the provision of engineering and technological support for engineering products at all stages of the life cycle. The implementation of the following principles is equally applicable to the organization and development of engineering and technical support for military, industrial and social structures during operation of machinery and equipment, provided in accordance with their areas of activity and tasks [3–5].

1. It is advisable first to focus efforts and resources on intensifying the development of already explored and developed areas. This allows to use them purposefully and as efficiently as possible using the concentration of all types of resources.

2. The development of the production and operational base for engineering and technical support for the operation of machinery and equipment should be based on the maximum concentration of production of goods, work and services, a rational level of specialization and autonomous functioning of military, industrial and social facilities.

3. It is advisable to determine the production, technological and economic parameters of objects of engineering and technical support for all areas of activity, their structure, buildings, technical equipment, and staffing with qualified personnel, taking into account real production conditions and sizes based on the development of pilot and standard organizational and technological projects.

4. The structure and parameters of engineering support facilities are determined by the need for modern technology, machinery and equipment for technical service, which depends on the level of their quality and, first of all, the quality of manufacture and reliability parameters. The cost of their operation, downtime for technical reasons, the efficiency of production processes and enterprises in general directly depend on the quality of manufacturing and reliability parameters of the machines and equipment produced.

Therefore, in the production of technology (including military), machinery and equipment operating in severe climatic conditions of the Arctic, a significantly higher level of quality is necessary. And if by the parameters of the technical level, by the technical and tactical characteristics, the vast majority of domestically produced machinery and equipment meets or exceeds the level of the best world analogues, the quality indicators and reliability parameters are lower, which significantly reduce the efficiency of their intended use. This requires solving certain organizational and technological problems of improving the quality of engineering products.

Methods and techniques
The fundamental requirement for conducting real organizational and technological research is to ensure a high degree of accuracy and reliability of the results at all stages of work. Therefore, modern methods were used to justify and optimize the parameters, collect, systematize and process the initial and statistical information about the production processes and use of machinery and equipment for its intended purpose, ensuring their performance and restoring the resource; research and evaluation of requirements for preventive maintenance and sudden failures; research and evaluation of the wear processes of critical work surfaces of the joints of machine parts and equipment, their components and assemblies; monitoring and analysis of the processes of creating and using a machine, assessing the technical condition and efficiency of machines and equipment in real use in the production of goods, works and services [4–10].

Research results
The solution to the problems of improving quality is the reorganization of the existing system of
manufacturers of machinery and equipment into proprietary production and technological systems
(firms) that can provide engineering and technical support for their products from the creation of
the machine to its disposal. All quality improvement processes are managed at all stages of the life
cycle of machinery and equipment. Due to this, a proprietary production and technological system
(firm) is able to ensure the achieved world (and higher) level of quality of domestic equipment, control
it and manage it.

The problems of improving the quality (competitiveness) of Russian technology, machinery and
equipment are systemic and require a comprehensive solution of production, technological,
organizational, economic and legislative problems and issues. Their solution will provide the required
level of quality not only of technology for the Arctic, but also of the entire national economic complex
of the country. Therefore, it is advisable to single out a set of problems of improving quality into a
special state program.

The main requirements for the quality of machinery and equipment for the Arctic are as follows.
The design of machines and equipment should provide a high level of ergonomic requirements and,
first of all, safety and comfort of personnel during their use and maintenance; have a high level of
reliability and, above all, failure-free performance; the frequency of planned preventive measures and
the mean time between failures should not be lower than that of the best world analogues. In the
manufacture of the main critical parts and joints, units and assemblies of machines and equipment, it is
advisable to use promising innovative materials, high-precision machining technologies and hardening
of working surfaces to increase their resource. During operation, new highly effective lubricants and
other working fluids designed specifically for harsh Arctic conditions should be used. Together, these
measures can provide an increase in the resource of machinery and equipment by 1.5–2 times.

Taking into account the peculiarities of the operation of machinery and equipment in the Arctic, the
equipment should be delivered with a specific set of tools for monitoring the technical condition,
performing maintenance operations and eliminating the consequences of simple failures by operators
and drivers directly at site or at the facilities of the repair and maintenance base [11–14].

As the main method of organizing technical maintenance of machines and equipment, it is
advisable to carry out maintenance or replace faulty parts and assemblies using the self-service method
(using their own resources) with the involvement of the forces and means of maintenance and repair
workshops. When performing technologically complex repair work, the aggregate repair method
provides the greatest efficiency.

6. Designing of objects for the repair and maintenance base of technological machines and
equipment is carried out taking into account the actual operating conditions of machines and
equipment, their parameters and design, needs for maintenance and repair, and the level of
specialization of work. When creating objects, it is advisable to use block-modular structures, from
which buildings and structures of the repair and maintenance base should be made easily and
practically without special technical means. Materials of block-modular structures must ensure high
environmental safety and low thermal conductivity.

7. The facilities of the repair and maintenance base should be equipped with modern universal
diagnostic and control and repair and technological equipment, machines, devices and tools in
accordance with their real needs.

8. For the efficient use of machinery and equipment, maintenance and repair tools and objects of
the repair and maintenance base, it is advisable to organize engineering and technical services staffed
by qualified personnel, whose main task should be to ensure the operability of the entire complex of
machines and equipment of an enterprise or group of enterprises. As criteria for assessing their
activities, we establish the level of serviceability of the serviced machinery and equipment [15–17].

9. In order to reduce the downtime of machinery and equipment for technical reasons at the
facilities of the repair and maintenance base, it is advisable to have an irreducible (constantly
replenished) supply of units, assemblies and parts, operational and repair technical materials.
Replenishment, control over the expenditure and safety of spare parts, operational and repair and technical materials are assigned to the engineering and technical service.

10. For a rational and highly efficient organization of production and economic activities of the engineering and technical services of enterprises and other mechanized structures, it is advisable to carry out organizational and technological design of services and their types depending on the areas of machinery and equipment used and its quantity at the enterprise.

11. When switching to the proprietary method of organizing the technical servicing of machinery and equipment, engineering and technical services may act as technical representatives of equipment manufacturers directly at site.

12. The effectiveness of the functioning of military, industrial, social structures, as well as structures providing engineering and technical support (service) depends on the completeness and timeliness of deliveries of high-quality and reliable equipment, fuel and lubricants and other operational materials and liquids, spare parts and repair technical materials, availability and creation of volumes of insurance reserves of these resources. This requires solving a large number of complex logistic problems by types and volumes of supplied resources, directions of consumers' activities and their territorial distribution, the presence and condition of roads and stable communication, the availability and condition of logistics centers, their technical equipment and many other factors.

Deliveries of machinery and equipment, material and technical resources for operation and ensuring operability are carried out by various supply trading and intermediary organizations, unsystematically as a rule, according to one-time applications. Machines, assemblies, units, operational and repair materials supplied by them usually have deviations from the requirements of GOST and TU for manufacturing. As a result, the cost of the supplied material and technical resources significantly increases, the quality of these products decreases, since the direct connection between the manufacturer and the consumer of machines and equipment is lost and there is no warranty technical service, the costs of machine downtime for technical reasons are huge [17–19].

13. The implementation of this concept requires the development of an innovative integrated system of training, retraining and advanced training of specialists: highly qualified specialists, engineering and technical workers and workers in the mass professions. The main innovative directions of development of the integrated training system should be:

- comprehensive improvement of the quality of domestic machinery and equipment for the Arctic;
- reorganization of existing manufacturing plants into proprietary production and technological systems (firms) capable of ensuring the world level of quality of domestic equipment;
- development and organization of proprietary engineering and technical services for manufactured machinery and equipment;
- development and implementation of promising and resource-saving technologies and technical means of machine use (production and technical operation);
- development and implementation of organizational and economic mechanisms to stimulate the quality improvement of manufactured machines, the use of resource-saving technologies and technical means, the introduction of effective forms and methods of organizing the production and maintenance of machinery and equipment.

The practical implementation of these requirements will reduce the need for equipment and its downtime for technical reasons, reduce the cost of maintaining machinery and equipment, minimize the need for a repair and maintenance base, investment in its creation and highly qualified repair and maintenance personnel.

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