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ENSURING THE COMPETITIVENESS OF INDUSTRIAL ENTERPRISES IN TERMS OF METHODS FOR ASSESSING THE QUALITY OF INDUSTRIAL PRODUCTS

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A B S T R A C T

The article examines the model of the quality management system based on international standards ISO 9000 series is generally recognized in the world. It is being implemented at enterprises of all forms of ownership operating in various countries and sectors of the economy. The standard has gained such wide popularity due to its versatility and approaches to quality management, which have shown their effectiveness and efficiency in practice.

In the modern world, the basis for ensuring a competitive advantage of an enterprise in the market is the continuous improvement of its management system and products. The ISO 9000 series of standards focuses the organization on continuous improvement and the fullest satisfaction of the requirements of all stakeholders. The quality management system is an important factor of competitiveness. The presence of a quality management system at the manufacturer means, in market language, the ability of this enterprise to meet the requirements of consumers, regulatory requirements from the state and the requirements of the organization for its own activities. In accordance with the General provisions of the standard, this is the main purpose of the quality management system. Modern enterprises operate in a constantly changing market environment. Only those companies that can quickly adapt to changes in the external environment can survive in the competition. In this regard, the quality management system should be flexible and quickly "adjusted" to changes in the requirements of the parties interested in the company's activities. Only such a management system can become a useful tool in the hands of the company's management.

1. INTRODUCTION

The quality of products is determined by the generalized properties of its production (reliability, durability, maintainability), which can satisfy certain needs for further operation.

A number of properties characterizes the quality of a product, and properties are indicators that quantitatively

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characterize one or more properties of this product. Often, density, resistance, etc express the properties of products and their quality criteria.

The quality of mechanical engineering products is an indicator of scientific and technological progress and production culture in mechanical engineering. The level of product quality in the machine-building industry has an important place, which is associated with the need to increase the competitiveness of products in the domestic and world markets. Ensuring and improving the quality of products in mechanical engineering is a complex task. Its solution is to improve the design of machines and their components, the use of new materials and automation of technological processes.

Product quality is a relative concept that can be analyzed quantitatively, that is, by comparison with basic products of similar purpose. The relative component of product quality, which is based on its comparison with the corresponding set of basic indicators, is called "product quality level". The values characterizing the properties of product quality are called quality indicators. They can be absolute, relative or specific. A product quality indicator that can take into account one of its properties is called a single indicator, two or more properties are called complex.

The criterion of the quality level of the product is an integral quality indicator that determines the ratio of the useful total effect of the product to the total cost of its production (Ageev & Chursin, 1988). Product quality management is carried out through systematic control of compliance of quality indicators with standards, technical characteristics, regulatory documents, targeted impact on the quality of documentation, equipment, tools, materials, components, on the level of qualification of manufacturers.

2. THE PROBLEM STATEMENT

The problem of the quality of mechanical engineering products acquires a special role in modern times. The quality of products is the main lever for increasing competitiveness in world markets, as well as one of the main components of economic progress (Nagle & Holden, 2001). A special place in the problem of ensuring the quality of mechanical engineering products is occupied by mechanical engineering technology, because new progressive design developments and research are implemented through it.

Mechanical engineering technology is a branch of science about the laws of the processes of manufacturing machines of the required quality, in the prescribed quantity and timing with minimal costs of living and materialized labor, material and energy resources (Ageev & Chursin, 1988). The main task of mechanical engineering technology is to ensure the planned quality of products in its manufacture. The

most effective approach to solving this problem is the technological provision of optimal parameters for the specified operating conditions of the state of the surface layer, the accuracy of the manufacture of parts and assembly of machines.

During use, the surface layer of the product is subjected to the strongest physical, chemical and mechanical effects. Therefore, the destruction of parts in most accidents begins with the surface layer (Vensel, 1983). Based on this, solving the problem of technological quality assurance of parts, it is necessary to develop such technological characteristics that will be able to provide the required parameters of the state of their surface layer, determined by the working conditions of the part, as well as the specified processing accuracy. Special attention should be paid to the formation of the surface layer of parts with various processing methods, the influence of processing methods and the state of the surface layer on the basic operational properties of machine parts operating under various loads, normal and high temperatures, in non-aggressive and aggressive environments. Attention should also be paid to the basic concepts and indicators of product quality, characteristics of the quality management system and certification of products based on international standards ISO 9000.

It is also important that in recent years the issue of ensuring the quality of machine-building products in developed countries is no longer a concern of individual companies, but is considered as a national issue. For example, in Japan, this issue is considered a major national problem, the United States annually holds a quality month, the Swedish government sponsors a nationwide campaign to improve product quality, and the Netherlands is developing a National five-year plan to improve the quality of products and components. Special attention to the quality of products in developed countries is due to changes in conditions, forms and methods of production due to increased competition in places of sale between leading companies in different countries. Most countries spend a lot of effort on improving the quality of their products, thereby determining their authority and position on the world market, in the fight against competitors.

The problem of ensuring the quality of manufactured products in mechanical engineering is particularly acute in Russia. This problem arises even in a directive economy, when all efforts to ensure and improve the quality of products are planned and controlled by the state (Bondaruk, 2019). However, at the same time, consumer requests are very poorly taken into account, and the quality of the products themselves is discussed according to the requirements of its consistency with regulatory documents, which, in turn, often lag behind the requirements and wishes of consumers. With a monopoly of producers and the absence of strong market incentives for qualitative growth-competition -

they are not interested in improving the quality of products, spending additional financial resources for these purposes. In this regard, the situation with product quality is aggravated by a growing shortage of goods, when demand increasingly exceeds supply and consumers, deprived of choice, are ready to buy goods of any quality and at set prices. That is why the problem of ensuring the quality of products is important and serious for the development, progress and prosperity of the country's economy.

3. THE RESEARCH

Market relations have exacerbated the problem of quality and competitiveness of manufactured products. An effective means of solving this problem is the implementation of the provisions of the ISO 9000 series of international standards, which reflect the concentrated world experience in ensuring product quality, and the main emphasis is on measures that guarantee stable output (Alekseenko & Ratner, 2020).

To achieve this goal, the organization must keep under control all technical, administrative and human factors that affect the quality of products. In order to achieve the goals defined by the company's quality policy, such a quality system should be developed and implemented, which covers 2 interrelated aspects:
1. consumer requests and expectations;
2. requests and interests of the organization.

Improving the quality of products is a constant well-coordinated work aimed at improving both the technical level of product quality and the quality of its manufacture, as well as improving production technologies and the quality system as a whole. The process of improving the quality system is recommended to be carried out in the following sequence:
- determine the direction of improvements and the means to implement them;
- to investigate the characteristic features of the problem;
- analyze the collected information, outline changes and, if necessary, experimentally check the options for changes;
- make changes to the improvement object;
- to analyze the functioning of the improvement object after making changes;
- document the found solutions for improvements.

The ISO 9000 standard defines key terms, interprets contractual terms, types of standards, and contains the basic principles for implementing the management's quality policy. It establishes and separates the rules for the use of quality assurance models related to the contract (ISO 9001), formulates three main tasks of the manufacturer in the field of quality, namely:
1. to achieve and maintain the quality of products

at a level that is able to ensure the continuous satisfaction of the goals of consumers;
2. provide the management with confidence that the required quality is achieved and maintained at a given level;
3. to provide the consumer with confidence that the intended quality of the supplied products is being achieved or will be achieved; ensuring confidence may mean mutually agreed requirements for providing evidence, if this is provided for by the contract (Dulesov, 1999).

Methods of assessing the quality of industrial products involve an assessment of the experience and business reputation of business entities. The regulatory framework for this can be the standard: GOST R 66.0.01-Assessment of the experience and business reputation of business entities (Standard: GOST R 66.0.01; GOST R Standard 66.1.03). The standard also approves requirements, models and indicators for assessing the business reputation of companies based on their operational experience. The standard provides a holistic and objective approach to the ranking and selection of organizations during tenders or competitions, and also participates in the assessment of the reputation and financial success of the company. The standard assumes the use of a factor model. A factor system model is a mathematical formula expressing real connections between the analyzed phenomena.

In general , it can be represented as follows:

$$y = f\left(x_1, x_2, \ldots, x_\varkappa\right)$$

where
y - is the effective feature;
x- factorial features that include weight characteristics that are empirical in nature (Standard: GOST R 66.0.01; GOST R Standard 66.1.03).

The problem of effective spending of budgetary funds as a tool for assessing the quality of industrial products in a difficult economic situation is becoming more and more urgent. This determines the importance of evaluating the effectiveness of the use of funds when placing a state and municipal order. The form of a state or municipal order is defined by Article 72 of the Budget Code of the Russian Federation and the holding of tenders and tenders on the basis of Federal Law No. 223-FZ (GOST R Standard 66.1.03). There are two options for effective spending of budget funds: According to the first option, the achievement of the necessary result occurs using the least funds. According to the second option, the lowest result is achieved using a certain amount of funds. This principle is sometimes implemented in a tender, where the evaluation of proposals takes place according to various criteria, and the goal is to conclude a contract on the best terms. In accordance with Federal Law No. 44 dated 05.04.2013-

"On the contract system in the field of procurement of goods, works, services for state and municipal needs", customers are given the opportunity to take into account factors of experience and business reputation when choosing a contractor during procurement within the "business reputation" criterion of a procurement participant (FZ-44). The standard enables public and private customers to apply professional tools that simplify the procedure for pre-selection of bidders by establishing an objective conformity assessment procedure approved in the Methodology for Assessing the Business Reputation of a construction organization. (Standard: GOST R 66.0.01; GOST R Standard 66.1.03).

The Law regulates relations that focus on ensuring state and municipal needs in order to increase the efficiency and effectiveness of procurement of goods, works, services, ensuring transparency and transparency of such procurement, preventing corruption and other abuses in the field of such procurement. The Budget Code of the Russian Federation, defining the efficiency and economy of the use of budget funds as one of the principles of the budget system, establishes the obligation of recipients of budget funds to use budget funds effectively in accordance with their intended purpose.

Conducting an assessment of experience and business reputation allows you to conduct:
- comparison of the company's level of development with competitors, adequate positioning of itself in the market;
- independent confirmation of the competence and professional success of the organization, including for participation in tenders for public and private orders within the framework of 44-FZ and 223-FZ;
- assistance to consumers in the competent selection of suppliers of goods, services and works;
- improving the competitiveness of business entities;
- formation of a business reputation management system (FZ-44).

Special attention in the ISO 9000 standard is paid to the conclusion of a contract, which, as a rule, is preceded by an assessment of the quality system in force at the enterprise in order to determine the supplier's ability to meet the requirements of standards and additional technical requirements for products or services specified in the technical conditions of the contract.

When developing the international standard ISO 9001:2015, a risk-based approach is used to create a QMS, which is one of the key changes in the new version of the standard. The basics of risk management in the updated version of the standard is integrated into the quality management system as a whole, and taking risks into account when making decisions turns preventive actions into part of the process approach. Risk management activities create the basis for improving the effectiveness of the quality management system, achieving better results and preventing adverse consequences. The organization needs to identify the risks and opportunities to be considered, as well as plan and implement actions to reduce them and evaluate the effectiveness of these actions (Vasilyev et al., 1998).

However, not all processes in an organization have the same level of risk in terms of their impact on the organization's ability to achieve its goals, and the consequences of inconsistent processes, products, services or systems are not the same for different organizations. In some organizations, the consequences of providing substandard products or providing substandard services can cause only minor inconvenience to customers, while in other cases, substandard products can lead to far-reaching consequences, up to a fatal outcome (Shishkin, 2020). Thus, risk-oriented thinking means that risk must be taken into account quantitatively when determining the seriousness and depth of the approach to planning and managing the quality management system, its processes and activities.

The text of the standard assumes the application of a risk-based approach at all stages of the functioning of the quality management system.

Risk should be considered not only as a negative phenomenon for the enterprise, but also as a positive opportunity to find directions for improving the production process. ISO9001:2015 does not require a full formal risk assessment after completion of the "risk registration" or any other document (Kouzen, 1963). As a useful, reference document on risk-based decision-making methods, GOST R ISO 31000-2010 "Risk management. Principles and Guidelines".

Therefore, in the conditions of mandatory transition to the new version of the ISO9001:2015 standard, interest in the use of risk-oriented methods in the construction of QMS will increase, and the developed methods and tools can be widely used. By improving management, ensuring high quality of products and services, increasing customer confidence and satisfaction, increasing the competitiveness of organizations using risk-based thinking.

In modern conditions, it is necessary to improve the quality of products. The quality of modern enterprises is becoming one of the decisive factors for increasing production efficiency and the overall intensive development of the economy (Solovyova, 2021). In addition, the production of low-quality products at individual enterprises and in the national economy as a whole caused huge economic losses. Quality determines the level of competitiveness of a modern enterprise by

one in the conditions of increasing competition for sales markets.

That is why improving the quality of products is the most important goal that can increase production efficiency. Production efficiency, in turn, is determined by the ratio of the results obtained and production costs (Galinovsky, 2022).

Methods. The need to assess the quality level of industrial products arises during its planning, certification and control.

When assessing the technical condition of homogeneous machines (parts), a differential, complex and mixed method is used, for heterogeneous machines (parts) – the method of quality indexing. When it becomes difficult to assess quality by quantitative indicators, they resort to expert assessments. The differential assessment consists in the fact that individual indicators are calculated according to the formula:

$$yk_i = \frac{Pi}{Pi_{\delta a \mathfrak{z}}},$$

where Pi is an indicator of the quality parameter of the machine being evaluated; Piáŕç is the corresponding quality indicator of the basic machine sample.

If the quality indicator has limitations (Pďđi), then the quality level is determined by the formula:

$$\acute{O}k_i = \frac{Pi - P\ddot{i}\delta_i}{Pi_{\acute{a}\grave{a}\varsigma} - P\ddot{i}\delta_i}$$

For a particular type of machine, all quality indicators are divided into 2 types: main and secondary. The technical level of the machine being evaluated is considered to be lower than the base machine if at least one of the main indicators is lower than a similar base indicator (Efimov, 2019). If the indicators are difficult to divide into main and secondary, then the assessment is based on complex or mixed quality assessments.

As a comprehensive assessment, a single indicator (P), an integral indicator (Ppi), a weighted arithmetic average (U) or a geometric (V) quality indicator can be used, thus:

$$U = \sum_{i=1}^{n} m_{iu} \cdot P_i \, ; \quad V = \prod_{i=1}^{n} (P_i) m_{iv} \, ,$$

where min miv - are the weighting parameters of the quality indicator; n is the number of indicators.

For evaluation by a mixed method, some indicators are combined into groups, while others are not combined. After that, they are compared with the group or individual indicators of the basic variant.

The quality level of heterogeneous machines is assessed by the quality index, which is found as the ratio of the value of the weighted average quality indicator of the evaluated and the base machine. The defect index can also be used to assess the quality of heterogeneous machines. This complex indicator is a weighted average defect rate, which is calculated by the formula:

$$U_{\ddot{a}} = \sum_{i=1}^{N} \alpha_i R_{\ddot{A}i} \, ,$$

where αi - is the weighting coefficient of this type of machines; RÄi - is the defect coefficient of machines, which is an indicator of the quality of manufacture of this type of machines; N - is the number of types of machines being evaluated.

Based on the objectives of this assessment and taking into account the significance of the quality indicators specified in the documents for this type of machine, the nomenclature of quality indicators is established (Dotsenko, 1983). At the same time, international, national foreign and domestic quality standards, documentation for the supply of machines, catalogs, brochures and standards of manufacturers of this type of machines, patent, competitive and economic documentation are taken into account.

4. CONCLUSION

The quality of products in modern conditions is the most important component of the efficiency and profitability of the enterprise, therefore it is necessary to continue to pay special attention to it (Nechaev & Prokopyeva, 2014). All participants in the production process-from the heads of the enterprise to the specific performers of any operation should be involved in improving the quality of the enterprise.

Improving the quality of products is the most important direction of intensive economic development, is a source of economic growth, is a benefit of social production. In these conditions, the importance of integrated product quality management and production efficiency increases.

The quality management system of various enterprises is individual. However, world science and practice have formed common features of these systems, as well as methods and principles that can be applied to each of them. In this article, the most effective and popular methods capable of assessing the quality level of products were considered (Nechaev et al., 2022).

Thus, the level of product quality is a relative characteristic based on a comparison of the values of indicators characterizing the technical and economic perfection of complex indicators of reliability and safety of use of the evaluated products.

The lack of economic efficiency of improving the level of product quality practically does not exist. Even enterprises or companies that produce products that are

not of high quality may be interested in improving quality, since this always means conquering new sales markets, expanding production, increasing profits and increasing competitiveness (Nechaev & Antipina, 2014). At the moment, there is an opportunity to modernize production and improve the quality of products according to all existing indicators. There are enterprises for which improving the quality of products is a secondary task, but the conditions of competition on the world market cause that such enterprises will sooner or later be forced to modernize their production, aiming the work of the enterprise at improving its quality management system (Egerev, 2003; Arsovski, 2023).

In conclusion, we can conclude that improving the quality of products will always be a positive and cost-effective factor in the development of any enterprise.

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