

The Content of The Operation Quality Concept of The Scientific and Technical Organization

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Abstract

This article highlights and clarifies the content of the basic concepts related to the quality assessment and satisfaction with the performance and products of the scientific and technical organization, as well as analyzes the generally accepted approaches and requirements of ISO 9000-2015 international standards to determine the operation quality of the scientific and technical organization. The authors clarify and complement the quality concept of scientific and technical products through the extended characteristics of all parties concerned. Based on the conducted analysis, the quality of scientific and technical products is considered in a broader interpretation, as a service, which includes the quality of the scientific and technical activities outcome as well as the quality of support service. The article highlights additional factors affecting the quality of products resulted from the scientific and technical operation of the organization. The authors consider the interrelation of categories such as “satisfaction” and “quality”. Special attention in the article is paid to the risk management as a necessary element of the quality management system.

Keywords: quality, effectiveness, innovation, scientific and technical organization, assessment, standard.

El contenido del concepto de calidad de operación de la organización científica y técnica

Resumen. Este artículo destaca y aclara el contenido de los conceptos básicos relacionados con la evaluación de la calidad y la satisfacción con el desempeño y los productos de la organización científica y técnica, así como también analiza los enfoques y requisitos generalmente aceptados de las normas internacionales ISO 9000-2015 para determinar calidad de operación de la organización científica y técnica. Los autores aclaran y complementan el concepto de calidad de los productos científicos y técnicos a través de las características extendidas de todas las partes interesadas. Según el análisis realizado, la calidad de los productos científicos y técnicos se considera en una interpretación más amplia, como un servicio, que incluye la calidad del resultado de las actividades científicas y técnicas, así como la calidad del servicio de soporte. El artículo destaca factores adicionales que afectan la calidad de los productos como resultado de la operación científica y técnica de la organización. Los autores consideran la interrelación de categorías como “satisfacción” y “calidad”. Se presta especial atención en el artículo a la gestión de riesgos como un elemento necesario del sistema de gestión de calidad.

Palabras clave: calidad, efectividad, innovación, organización científica y técnica, evaluación, estándar.

1. Introduction

A number of public documents of the Russian Federation define the goals and strategic directions to improve the scientific and technical scope. Certain documents (Development of science and technology for 2013-2020, 2014; Concept of long-term socio-economic development of the Russian Federation for the period up to 2020, 2008) in the basic provisions touch on the relevance and problems faced by scientific and technical organizations.

Thus, in the Concept of long-term socio-economic development of the Russian Federation for the period up to 2020 (2008), it is noted that the purpose of the state system formation to support innovative and technological development consists in primary updating of technological production. Global modernization should be carried out using advanced scientific and technical developments. Exactly these measures should ultimately form a competitive sector of research and development (R&D), ensuring

the innovative development of the economy. The transition to the model of innovative behavior of citizens and scientific and technical organizations will provide support for the expansion of innovation in all sectors of state life.

The State program of the Russian Federation “Development of science and technology for 2013-2020” (2014) sets the creation of a competitive, efficient, sustainably operating research cluster and the development sector as a target setting, ensuring its leading role in the Russian economy in terms of its technological modernization. The government tasks, which should be effectively implemented within the framework of the program, include the following: priority development of fundamental scientific research; forcing the priority directions of scientific and technological development by forming an advance scientific, applied, research, and technological groundwork; institutional transformation and improvement of the structure of the research cluster and the development sector, and others. The challenges are not limited to the public sector. Both the state program and the concept proceed from the perspective of integrating the Russian research sector of scientific and technological developments into the international scientific and technological community. The legal acts of the Russian Federation, such as the “Doctrine of the development of Russian science” (1996), the Federal law “On science and state scientific and technical policy” (1996), as well as the “Regulation on the organization of scientific research ...” (2000) became the statutory and regulatory support of science and technology.

2. Setting the problem to assess the activity of the scientific and technical organization

Turning to the problem of assessment, it is necessary to clarify the basic definitions used in the field of scientific and technical activities. Not giving strict definitions of scientific (research) activities, scientific and technical activities, and experimental development, within the framework of the article, we will dwell on the definitions of the subject of this work, i.e. on the scientific and (or) scientific and technical result, or scientific and (or) scientific and technical products.

Scientific (scientific and technical) result can be considered as a solution or product of scientific (scientific and technical) activities, which include synthesized new knowledge, as well as effective technological solutions. Scientific (scientific and technical) products result from scientific activities, which can be implemented in the relevant market.

Let us dwell on the subject of this study, namely, the activities of scientific and technical organizations, scientific and technical activity, as well as scientific and technical products. The scope of management science subjects includes key categories and definitions of “activity”, as well as “organization”. At the same time, the term “product” acquires economic sense in terms of a result, i.e. “process outcome” characterizing organization’s activity in general, especially when it becomes the object of purchase and sale. The definition of “scientific and technical” represents an aspect which turns out to be related to research. This category is formed by the development laws of science, engineering, and technology.

The issues of scientific and technical products definition and classification are considered in numerous works of modern domestic researchers, namely V.A. Akimov, A.A. Bovin, O.V. Vasyukhin, E.V. Goncharova, N.Yu. Yurchenko, and others, as well as are reflected in the regulatory documents. It should be noted that the definition of scientific and technical products is given in the current Federal law #127-FZ (1996), which considers it as a scientific (scientific and technical) result intended for sale on the market. At that, the legislation considers intellectual activity to be such a result. The result of scientific and technical activity can take the form of a new concept, theoretical structures and models, visual graphics images, sign systems, and other information that contains new knowledge (Lebedev, Pukhova, 2017). In aggregate, the result provides a similar understanding, reproduction, and assimilation. Recommendations (Recommendations: Product development and launch system, 1993) denote scientific and technical products to be a result of the completed design, development, research, as well as technological works, including services for their execution intended for the implementation.

In this work, the scientific and technical products will be understood in the framework of the generally accepted definition as the finished design, research, and R&D outcomes accepted by the consumer. According to the most researchers, including the authors, features of scientific and technical products consist in the fact that the properties of these products are, as a rule, subjective, intangible, as well as nonreproducible, and therefore uncertain. For a large amount of scientific research, the outcome is not uniquely interpreted, there are no clear assessment criteria, and therefore, there are risks of not getting the desired result.

3. Quality of the scientific and technical organization’s activity as a concept of the ISO 9000 international standard

The quality of scientific and technical research and development is the most important problem of the modern society and scientific and technological progress. Improving the quality of scientific activity becomes relevant by constantly updated requirements of an innovative economy. The expansion of science is associated with its high development rates. The need for quality management in various scientific areas is associated with the growth of R&D costs on the part of the state, business, and individuals as innovative products consumers.

Quality management of scientific and technical objects, including scientific and research area, is covered by international standards (Quality management systems: Requirements, 2015; Basic provisions and dictionary, 2015). The current version of ISO 9001 significantly differs from the 2008 version. These differences are as follows:

- positioning of ISO 9001 as an organization's management system;
- tightening the responsibility of the organization's top management;
- unifying structure and harmonizing with ISO 31000 on risk management;
- practicing the customer-oriented approach of ISO 9001 on efficiency, and obtaining a real result;
- defining risk analysis mechanisms (with regard to requirements) and risk management approach at the stage of design and management system development, etc.

New terms defined in paragraph 3.6 (Quality management systems: Requirements, 2015), such as for example, objects of quality, have the right to a broad interpretation and inclusion of the concept of "organization's activities", which must be studied from the standpoint of quality content. Another regulation in the field of quality is MS ISO 9004:2009 (known in the Russian Federation as GOST R ISO 9004-2010) (Basic provisions and dictionary, 2015; Management to achieve the sustained success of an organization: Quality management approach, 2010). This standard is based on requirements and conditions for improving the effectiveness and efficiency of the organization's quality management system. This document uses promising trends and advanced practices in quality management. The ISO 9004 was developed based on the standards of the Japanese Standards Association JIS/TR Q 0005 and JIS/TR, dedicated to sustainable development and self-assessment, French ANFOR, and Spanish AENOR standards, EFQM, as well as models of M. Baldrige, and E. Deming. Clarifying the authors' opinion stated in the publications (Pokrovskaya,

Sidorin, Sidorin, 2013; Kremcheeva, Kremcheev, 2018; Alekseeva, Gildingersh, 2018; Vinogradova, Leontyuk, 2018; Zhambalova, Vinogradova, 2018) concerning the fact that the quality management system documents determine the quality of scientific and technical products in accordance with GOST R ISO 9001, one can state the compliance of the result of scientific and technical activities with requirements of the technical specifications, as well as the terms of the contract at any stage of the life cycle of such products.

Despite the abundance of regulatory and methodological sources for the management system construction, the domestic literature lacks a clear concept of the scientific and technical products quality or the functioning quality of the scientific and technical organization.

The few works of modern researchers reflect the quality concept of scientific and technical products and, accordingly, the activities of the scientific and technical organization. The works of R.A. Durnev, A.S. Klepikov, M.V. Korovkin, D.O. Korchagin, S.N. Larin, M.I. Liborakina, V.A. Mironchuk, V.G. Mitikhin, A.A. Molchanov, M.V. Pokrovskaya, V.Yu. Savelev, and A.A. Sulemova focus on the severe requirements for the quality of scientific results. The major focus is directed to the factors which affect the labor intensity and implementation costs. The possibility of mass implementation of scientific results in the near future, as well as the positive effect of such implementation, is associated by R.A. Durnev with quality indicators. All authors concur that the quality of the scientific result is ultimately assessed by indicators, such as reliability, as well as practical and (or) scientific novelty.

Based on the analysis of the scientific and industrial enterprises' practices, D.O. Korchagin et al. (2010) emphasize that in the present conditions the successful implementation of the requirements of the quality management system when designing and developing scientific and technical products is due to the improvement of the organizational and methodological component of the enterprise's operation quality. The authors formulate a thesis about the competitiveness of products of the scientific and technical organization, which is determined not only by technical and economic indicators of the created product but also by other factors. To this end, the compliance of the essential requirements of GOST R ISO 9000 to standards of the system of development, design, and commencement of production is established in the framework of the organization taking into account specifics of the implemented research and developmental works.

The scientific and production activities are grounded on quality manage-

ment processes of obtained outcomes, which in turn are determined by a set of characteristics. Additional factors affecting the quality of products resulted from the scientific and technical activities can be represented graphically (Fig. 1).

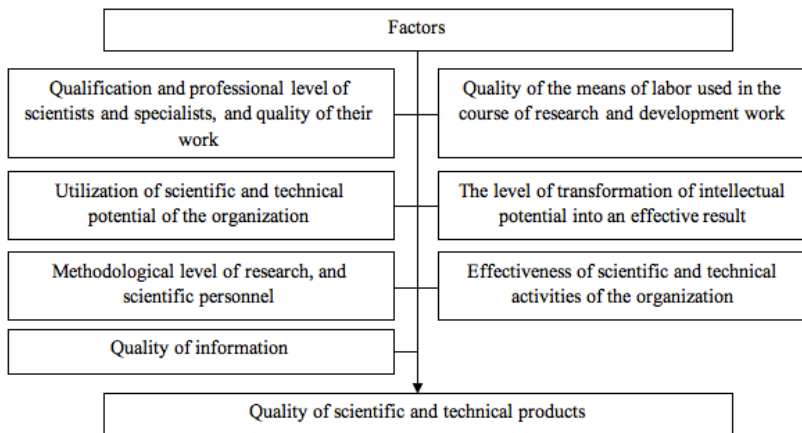


Figure 1. Product quality components of scientific and technical activity.

The analysis of modern literary sources indicates the absence of a strictly defined quality concept of the scientific and technical organization. There is no common understanding of the quality management model of scientific and technical activities and management of its outcomes. Defining quality categories of scientific and technical production, and the scientific and technical organization's activity, it is necessary to begin with strict formulations of the total quality management theory. Without contradicting the approach established in GOST R ISO 9000-2015, the concept of quality of the scientific and technical organization's activity can be defined as compliance with the requirements of the inherent properties of this organization. The requirements are formulated by the organization itself, as well as the parties concerned in the implementation of this activity. It is worth noting that the key definition of "inherent characteristics" along with the requirements has strictly defined sectoral nature (scientific area). Therefore, scientific and technological works are determined by the quality, which depends on the degree of compliance of the parameters reflecting the results of these works to the needs of society, the end user, as well as employees and the founder of the scientific organization. The definition of work or products quality should be considered as the quality of both the

result and the activity of a scientific organization. Thus, the quality of scientific and technical products plays the role of an internal characteristic of the quality of the very result and the process of the scientific and technical activity.

To assess the quality level of the scientific and technical organization's operation aimed at improving its management and development, one can offer the following concept of quality management model of scientific and technical activity, which includes the following main elements:

- requirements of parties concerned;
- quality parameters hierarchy of the scientific and technical organization;
- risks related to the external and internal environment;
- qualitative analysis of the scientific and technical organization;
- analysis of satisfaction with the quality of scientific results (scientific and technical products) of parties concerned;
- feedback to improve the quality of the scientific and technical organization, as well as its activities, based on monitoring data (Fig. 2).

The scientific sphere, reflected in the model as a party concerned in the activities of the scientific and technical organization, possesses industry-related specificity, whose indicators can be represented as follows (Fig. 3) (Zhambalova, Vinogradova, 2018).

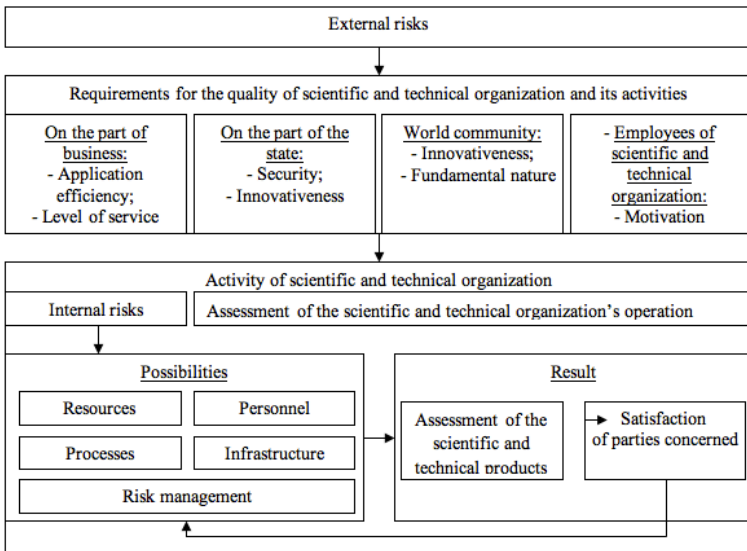


Figure 2. Model of scientific and technical organization's operation quality.

The consumer of scientific and technical products should be considered the entity, which finances scientific and technical works and uses the results of these works. The specificity of the scientific industry consists in the fact that while developing quality requirements, the quality formulated by other parties concerned are taken into account along with consumer requirements.

Requirements for scientific and technical products, as a rule, are laid down in agreements and statement of work. They define the basic conditions for the scientific and technical organization. In accordance with their specificity, they are being harmonized with the requirements of other parties concerned.

| Concerned parties | Quality requirements | Main indicators |
|--|--|--|
| Business and third parties | <ul style="list-style-type: none"> - High quality of performance; - High level of efficiency when using scientific and technical products; - High level of innovation; - High servicing level. | <ul style="list-style-type: none"> - A comprehensive quality indicator of the scientific and technical organization; - Business and third-party satisfaction. |
| State and national societies | <ul style="list-style-type: none"> - State quality requirements; - High level of safety, environmental friendliness; - The efficiency of science and innovation; - Fundamental research: development of science, laws, principles; - Applied research: development of innovative organizations. | <ul style="list-style-type: none"> - Innovative development indices, the rating of the state; - Public satisfaction with the quality of scientific and technical products; - Public recognition of the scientific and technical organization. |
| International community | <ul style="list-style-type: none"> - Development of world science and innovation; - Formation of knowledge for the mankind development. | <ul style="list-style-type: none"> - The innovation development indices, country ranking; - World community satisfaction. |
| Employees and founders of the organization | <ul style="list-style-type: none"> - The motivation of highly productive activity in the organization. | <ul style="list-style-type: none"> Salary, income. - Personnel satisfaction; - Public recognition. |

Figure 3. Industry-specific requirements to quality of the scientific sphere.

Turning to Fig. 2, let consider the relationship between the definitions of “satisfaction” and “quality”. Satisfaction mainly depends on many factors, primarily, expectations, preferences, and others. Satisfaction caused by “unexpected” useful properties (for example, individual scientific approach) grows in accordance with the theory of expectation more rapidly than the “objective” quality (where requirements are fulfilled in full in accordance with the contract), which can remain at the same level.

The synthesis of single quality indicators, in general, determines the quality of the scientific product, activity, and organization. These indicators can be assessed qualitatively, as well as have the quantitative and (or) cost

nature. The qualitative characteristics of the scientific and technical organization's activities currently do not have a specific generally accepted interpretation.

The modern development of scientific knowledge and technology requires constant rethinking and new formulations of definitions in the field of quality proceeding from the nomenclature of the properties of the scientific industry object and the goals of parties concerned in quality of scientific and technical activity. To this end, it is necessary to concretize the traditional generally accepted concepts of the quality of scientific and technical activities. These concepts include the quality of scientific products, as well as the quality of the process while considering it in the form of service that combines the result of certain activities, as well as rendering consumer services.

The quality of scientific and technical products is characterized by the scientific and technical level of the product itself. The scientific and technical level is described by well-known characteristics, such as functionality, manufacturability, reliability, and others that determine the technical aspect of the product of scientific and technical activity. However, the quality of scientific and technical products is a broader concept, because it includes the quality of interaction and service rendering to the customer; that is, contractual relations are of paramount importance in quality assurance. Therefore, the contract (statement of work) is the basis of the basic quality of scientific and technical products. On the other hand, the quality level of scientific and technical products is not determined by the performance of contractual relations, since its comprehensive assessment requires taking into account the service and interaction of the scientific and technical organization with consumers.

Thus, the quality concept of scientific and technical activity and production includes:

- the basic quality of the result, that is, the implementation to the full extent of the contract subject on the creation of scientific and technical products (scientific result);
- the quality of the interaction process and customer service in the course of the provision of scientific and technical services.

The comprehensive quality indicator of the scientific and technical organization's activity reflects the degree of compliance of the parameters of the organization's activity that form a set of characteristics of the established requirements with respect to:

- efficiency and effectiveness of all processes;

- risk analysis of the organization's activities;
- the generalized indicators of the quality level of outcomes resulting from the organization's activity in general, including satisfaction of consumers.

Currently, a mandatory requirement of ISO 9000-2015 concerns consideration of risks, their analysis as a relevant category of quality theory. Risk management becomes a necessary element of the quality management system. According to the requirements of ISO 9001-2015, the organization must systematically define external and internal risks (threats) affecting its activities.

Risk management is an independent area in the management theory. The GOST R ISO 31000-2009 standard (Risk management: Principles and guidelines, 2009), based on the process approach in the management of the organization, is the basis for risk management within the overall management of the organization.

It should be emphasized that the risk indices of the scientific and technical organization's activity together with the parameters characterizing its effectiveness and efficiency form a system of comprehensive indicators reflecting the quality of the scientific organization. Higher quality is peculiar to the activity of the scientific and technical organization with a high level of risk management. According to (Risk management: Principles and guidelines, 2009), risk management should include assessment of the internal environment of risk management, definition of the objectives of the scientific and technical organization, taking into account the risk management processes, the division into threats (risks), and the development potential for the internal and external factors that determine the implementation of goals. Along with the listed elements, it is also necessary to assess the risk probability, determine the risk-reducing procedure, respond to risk using relevant methods, as well as carrying out monitoring of the risk management process of a scientific and technical organization.

It is necessary to highlight the quality assessing an aspect of the scientific and technical organization. The total quality management theory sets the basic goal of achieving the satisfaction of all parties concerned. This requires an assessment of this indicator for the effective management of the organization.

The main assessment of the quality of the scientific and technical organization's activity is determining the level of satisfaction of all parties concerned with the quality of scientific and technical products. Domestic and foreign experience in the application of a large number of methods al-

lowing conducting customer satisfaction analysis indicates that currently unified method of assessing the quality of the scientific and technical organization is not available.

Recently, the consumer satisfaction index (CSI) proposed by the Stockholm School of Economics, and the American Customer Satisfaction Index (ACSI) offered by the University of Michigan, have enjoyed the greatest interest. Contemporary domestic and foreign researchers devote more attention to the issues of satisfaction assessment. The main implementations of CSI (ACSI) models are generalized based on the analysis of scientific data on the issues of determining satisfaction with the quality of scientific and technical activities (Luo, Bhattacharya, 2006; Fornell, 2016). They include the choice of the main and secondary factors affecting the degree of satisfaction, as well as the development of a point scale to measure these factors and an assessment of the ideal model. The model includes the questions of developed oral or written consumer questionnaires for direct or implicit determination of consumer opinion. The determination of the satisfaction index and analysis of its changes is conducted based on the subsequent collection of consumer opinions and information processing. The current version of ISO 9001-2015 contains a requirement for performance evaluation. According to section 9.1 (monitoring, measurements, analysis, and evaluation), the organization, including scientific and technical institution, independently establishes the required amount of monitoring and measurements, determines the used evaluation methods, which ensure the recognition of monitoring results, the time of monitoring and measurements, the order of analysis and evaluation of monitoring and measurements results.

The scientific and technical organization, when carrying out monitoring activities in accordance with the requirements of the standard, is obliged to document and store relevant information about the results obtained. Based on this information, an assessment is made of one's own activities and the effectiveness of the quality management system.

In accordance with this standard on satisfaction analysis, the organization should establish methods for obtaining and using information based on the monitoring results.

To analyze and assess the quality of scientific and technical activity objects, the organization needs to consider addition indicators which reflect their essence. The formation of single and comprehensive characteristics of the scientific and technical organization's quality is the subject of qualitative study.

4. Conclusion

The problem of assessing the quality of the scientific and technical organization's functioning and the quality of its products is undoubtedly relevant in the rapidly developing global scientific community. The concept of the long-term development of Russia notes the insufficient contribution of innovative and high-quality scientific and technical developments in the technological advancement of the country. The science development program in the Russian Federation sets the goal to form the scientific activities, providing a high quality of scientific and technical products in the medium term. Achieving this goal depends on the performance quality of scientific and technical organizations, which are an important part of the scientific cluster of the Russian economy, a potential driver of world science development, as well as innovative advancement of Russia. Qualimetric assessment of scientific and technical organizations is a structural element of quality management. The modern value system includes the quality of the organization and its results among the most important indicators of competitiveness that ultimately determine the viability of the state and the quality of life of its citizens.

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