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Issue Article

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POSSIBILITIES OF NORMATIVE AND TECHNICAL DOCUMENTATION OF THE QUALITY MANAGEMENT SYSTEM TO ENSURE THE PRODUCTION OF IN-DEMAND PRODUCTS

Abstract: *In the article, the authors assess the strategy of producing competitive and in-demand products, which is possible only with the presence of managers who are professionally trained and politically responsible for the results of their activities. In addition, the authors reasonably believe that the political responsibility of the heads of light industry enterprises is the highest measure of expressing their professionalism. But at the same time, I would like to note that their failure to fulfill political promises and statements is evidence of either their inability to engage in economic policy, or the use of political management is carried out by them in their personal interests, alien to the interests of society, provoking the impoverishment of the people, characterizing the immorality of leaders, which, of course, is unacceptable. And it is clear that there are no such objective reasons that would justify the decline in production in the light industry, so the results of the assessment of economic policy should be either useful or harmful - this should always be an axiom. If this does not happen, then something in this very economic policy is not a professional decision, the actions are harmful to society and timely adjustments are necessary. The authors recommend that the market review the concept of forming it with popular and import-substituting goods, taking into account their attractiveness. Such a concept will fully correspond to the consumer's desire to satisfy his aspiration and desire to make a purchase, taking into account his social status, ensuring that manufacturers sell their products in full and guaranteeing enterprises sustainable TEP of their activities.*

Key words: *quality management, the meaning of the standard, congruence, demand, assortment policy, footwear, assortment, light industry, import substitution, product priority, sustainability of the TEP from the enterprise's activities.*

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Introduction

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The problem of ensuring the quality of activity is not just universal, it is relevant, it is strategic.

What is the essence of economic reforms and the importance of industrial policy in them, which are theoretically substantiated and tested in practice in a number of developed countries?

This is the fight against inflation, strengthening of the national currency and financial stabilization. This is a change in the forms of ownership in various spheres of the economy through the process of privatization. This is a structural reorganization of the economy to the conditions of market relations.

At the same time, structural restructuring must be the basis of all these fundamental processes of economic reform. Both financial stabilization and privatization must be subordinated to the process of structural restructuring, since it is precisely structural restructuring that determines the final result of reforms and the effectiveness of the adaptation of various forms of production to civilized market relations.

The basis for the structural restructuring of the economy must also be the final result. And this is the products, services - their competitiveness in the domestic and world markets.

What was happening in the Russian reforms? All three basic processes (financial stabilization, privatization and structural restructuring) were going on by themselves, without any mutual connection with each other. Therefore, the methods that were used by the government and the Central Bank to combat inflation and other economic indicators often ran counter to the tasks of structural restructuring.

As for the process of structural restructuring, the government's position is expressed by the following statement: "the market itself will put everything in its place." With such a position on structural restructuring, it is not surprising that in the national economic policy at that time there was no place for the words quality, competitiveness, import substitution.

This is, unfortunately, the reality of the reforms carried out today. In this regard, I would like to refer to the well-known world experience.

Let us conduct a general factor analysis of the problem of "quality of life". The quality of life of citizens depends on the quality of consumed goods and services in the full range - from birth to funeral services, as well as on the solvency of citizens, which allows them to purchase quality goods and services. The two factors named (quality and solvency) depend on the state of the country's economy, which in turn depends on the efficiency of enterprises in various sectors of the economy, including light industry. The efficiency of enterprises depends on the state of management, on the level of application of modern management methods.

The current global practice of widespread use of modern methods is based on standardization and certification. Standardization allows for the generalization of best practices, formalization of them in an accessible and understandable form and making them available to all those wishing to apply these best practices. Certification allows for the assessment of the level of implementation of standard requirements in practice and for providing an appropriate guarantee for the consumer. At present, no more effective mechanism for disseminating best practices has been invented. experience in solving various problems, and corresponding international structures for standardization and certification have been created in the world.

At the same time, international quality management standards have the most significant and global character. The use of modern methods in them allows solving not only the problem of improving quality, but also the problem of cost-effectiveness and the problem of productivity. That is, today the concept of "quality management" is moving into the concept of "quality management".

Thus, all this taken together will provide light industry enterprises of the regions of the Southern and North Caucasian Federal Districts with a stable position both in the domestic and in the markets of the near and far abroad. All that is needed is the good will and interest of all participants in this process.

Main part

Development and implementation of a quality management system (QMS) is a set of works that concerns various aspects of the enterprise's activities, document flow, personnel management, production subsystem, internal communications, strategic management subsystem, logistics subsystem, sales and product sales subsystem.

Therefore, the development and implementation of the QMS is a very labor-intensive and lengthy process, which, as a rule, is implemented in several stages. The typical scheme is as follows. At the first stage of creating the QMS, the management of the enterprise defines the goals, policy, and obligations in the field of quality, observing the following principles: policy is the basis for determining the goals necessary to improve product quality; quality policy is

part of the general strategy and policy of the enterprise. When creating the QMS, the manager issues an order to begin work on the quality system, where he specifies: the purpose and time of the start of work; the person responsible for the implementation of the quality system from the management of the organization; the composition of the working group for the implementation of the quality system. The responsibilities of the head of the enterprise include general management of the work and making strategic decisions on the development and implementation of the ISO standard. The manager, as a rule, is responsible for the final result of the work. Any management system is a means of managing goals. Accurate formulation of the goals of the enterprise largely determines its competitiveness and success. The main tasks and goals on which the quality management system of any enterprise is based, namely:

formation of requirements for the development, production, and supply of high-quality products, aimed at the constant satisfaction of established, expected consumer conditions;

providing the customer with a guarantee of high quality products;

creating confidence among the company's managers that the proposed tasks in the area of quality will be completed.

The most important tasks of the quality management system are, namely:

participation of active management of all processes that affect product quality as a means of preventing the occurrence of non-conformities;

the order of responsibility, as well as the powers of management at all levels of management;

creation of process management, according to the so-called closed-loop principle from the consumer's conditions through the execution of processes with the inclusion of feedback to resolve his satisfaction with the accepted results (PDCA);

establishment of effective control over the conformity of products with consumer requirements, as well as organization of control over the status of processes;

normative and methodological organization of quality assurance work;

involving all personnel of the organization in the work on ensuring product quality, rewarding the creativity and initiative of performers;

identification of some problems related to the category of non-conformities, elimination of the possibility of their repetition, optimization of the QMS in terms of quality costs, given the existing resource limit.

The quality management system operates in conjunction with all types of enterprise activities (technical, organizational, technological, legal, economic, social), covers the work of personnel of all services and divisions providing material and technical supplies (purchases), design, production, testing and control of products, labeling, preparation of quality documentation, preservation, transportation, packaging, storage, delivery, disposal.

The current QMS covers as many as four quality points, expressing the product life cycle paths, namely:

quality determined by the determination of demand for the organization’s products and its marketing;

quality determined by the design of the organization's products - design, as well as development;

quality determined by compliance with the design during the manufacturing process;

quality determined by maintaining the conformity of the product delivered to the consumer for operation.

There are several reasons that necessitate the presence of a functional quality management system, namely:

a significant increase in the productivity of products at a specific enterprise;

increased consumer confidence in manufactured products;

entering domestic and global markets by expanding the sphere of influence.

Only technological innovations can provide an order of magnitude increase in labor productivity. The image of an enterprise influences the growth of trust to a certain extent, but it requires constant maintenance taking into account the analysis of the market for manufactured products. The globalization of markets has led to the fact that sales volumes have become decisive, and inefficiency and costs. Focusing on the export of products is fraught with further de-industrialization of the Russian economy, That's why implementation New technologies are needed, first of all, in the domestic market.

The process of implementing a quality management system includes a whole range of works. All this can affect various aspects of the enterprise's activities. In addition, the implementation process can also affect the subsystems of the quality management system - the logistics subsystem, the production subsystem, the company's strategic management subsystem, the personnel management subsystem and many others. From this we can conclude that the need to implement a quality management system is a rather labor-intensive and lengthy task. In most cases, the development and implementation of a quality management system is carried out in several stages, namely:

analysis of the current situation at the enterprise, as well as staff training;

development of necessary documentation and changes in the schedule and working conditions of employees;

the need to conduct an internal audit of the

quality management system.

Following these stages is a labor-intensive process, including the implementation of complex and extensive work. The longest and most demanding stage is changing the schedule and developing the necessary documentation for the company's employees, so the need to perform individual works is very acute. And the first stage is the most critical when implementing this system. The development and subsequent implementation of quality management is an important and necessary work.

Every day, the requirements for quality and safety increase, thereby forcing us to follow world standards more strictly. As a result, the interest of enterprises of the Russian Federation in the need to implement a quality management system is increasing and does not raise any doubts about its effectiveness. At the moment, there are quite a large number of models for the creation, implementation, and further improvement of the QMS, the history of which dates back to the 1950s. It should be noted that over time, one model replaces another, as this system is constantly being modernized.

When approaching the implementation of organizational projects dedicated to increasing the efficiency of the company, managers often encounter such a problem as an isolated quality management system. Such a system is not very effective in practice and is not able to improve the company's activities. Experts note that most managers of Russian enterprises highlight the following reasons that slow down the implementation of a quality management system at enterprises, namely:

difficulty entering international markets;

receiving a government order;

high demands from customers, legislation, and parent companies;

participation in tenders;

attracting additional investments, taking out loans.

There is a certain formality in the implementation of a quality management system (QMS), which entails a lack of understanding of the necessity of such a system. International practice has confirmed that the success of a company can only be brought by its targeted implementation, which will give the desired result. Therefore, each manager, all personnel must understand the need to introduce a quality management system. Unfortunately, at the moment, the quality management system is unsuccessful in Russia. The reason for this is the erroneous understanding of the role of quality management in the overall management system. But the need for a QMS is great for domestic enterprises. To understand the importance of implementing a QMS, it is necessary to consider the classification of enterprise functions, namely:

primary activity. It is aimed at implementing the processes of the life cycle of a service or product: production of specific products, provision of services;

secondary activities, including management: aimed at increasing the efficiency of primary activities;

activity that regulates secondary.

The activity regulating the secondary is also included in the QMS, since its role is to present the requirements for the management system at the enterprise and monitor their implementation. The competition that exists between companies is the primary activity. And only the ability to use and apply modern management technologies will help the enterprise to increase the efficiency of the QMS.

Thanks to the quality management system, it becomes possible to consider the management of all production processes as transparently as possible. The implementation of the QMS is confirmed by a certificate, which allows us to guarantee the quality of the manufactured products and an advantage over competitors. The certificate is an important tool both for confirming quality and for attracting consumers.

The implementation of the quality management system does not end with the receipt of the certificate. For the next 3 years, enterprises will have to undergo supervisory audits, which are carried out under the control of the relevant body. Therefore, it is necessary to maintain and ensure the achieved level, confirmed by the certificate, making maximum efforts. The integration of the quality management system into the unified company management system in full begins precisely at the stage of obtaining the certificate. At the early stages, the efficiency of the QMS is low, since the need for the system to maintain and ensure its effectiveness implies the expenditure of large resources. Often the amount of resources expended is many times greater than the effectiveness, and in order to make the transition from effectiveness to efficiency, using new methods of improvement, it is necessary to consider and find a solution to the following problems:

Consistency between the quality management system and the enterprise's goals. Achieving the set goal from the implementation of the QMS will be possible only with a common focus.

Planting a full process aspect. Often, such a factor as a process approach remains only in theory and is not implemented in practice, due to the complexity of implementation in enterprises with an effective organizational structure. When implementing a process approach, a number of structural changes are necessary, which can subsequently cause additional difficulties.

Construction of a reporting system on the functioning of the QMS, which will be a fundamental fact for the implementation of management decisions.

The quality management system increases the customer's interest in the product and attracts more and more than lower quality products. And these are good positions for competitive struggle in the market.

Quality growth is also necessary for more complete satisfaction of consumers. Having established the quality level, the company must adhere to it or increase it, since a negative process can adversely affect the image of the product and efficiency. Quality management will help to more effectively control the quality of manufactured products at the required level.

On the other hand, increasing the quality level will lead to higher production costs, which will affect the price of the product. And here it is necessary to adhere to the golden mean. The product must satisfy the needs of consumers in quality and safety, but also have a price that will be acceptable to them. Of course, the introduction of a quality management system can have a positive effect on the attractiveness of the product, and then the market share can grow, but it is better to initially set the quality level of the product and adhere to it, so that the consumer is confident in the quality.

For this, there is a need to study the external environment for more accurate information about the product. By studying this information, the enterprise will be able to respond in time to changes in consumer demand. But it is also necessary not to forget about the internal environment of the enterprise and monitor trends in the work of all line personnel. To control the entire volume of information, a quality manager is needed who can put everything together and adhere to the quality control system.

A quality management system is a step that all our enterprises must take in order to be competitive and successful not only in the Russian but also in the global markets. When implementing a quality management system, it is necessary to know the main factors, namely:

When implementing a quality management system (QMS), it is necessary to give it full control at the enterprise. If in small productions the exchange of information occurs quickly, then in large enterprises the time of decision-making can significantly delay the adoption of the necessary decision. But in order for the quality control department to be able to make a competent decision, it is necessary that trained specialists who are not afraid to make decisions sit on the ground.

Attracting a qualified quality manager. These personnel are necessary for a full-fledged quality management system. He must have all the necessary skills and knowledge. In order for him to be able to make timely, necessary decisions, it is necessary to know the entire production and who exactly does what in order to have a complete picture of the issue and an accurate response to it. He must also have good leadership qualities so that he can set the staff up for effective work. He must know quality management systems and have knowledge of ISO 9000 and GOST and be well versed in them. Also, the department under his control must report directly to top management for faster decision-making. In order for the work of the Quality Manager to be effective, it is necessary to subordinate him to the first head of the organization, give him all the necessary powers to manage the QMS processes. Line personnel must also be involved in the process of implementing the quality management system. To improve skills, companies can conduct trainings or send personnel to other enterprises to exchange experiences and improve personal skills, but such a process is possible for companies that already have other production facilities that have rich experience in quality management or between enterprises located in the same cluster. It is also worth encouraging personal initiatives of employees to improve their qualifications or personal skills.

Conclusion

Compliance with the principle of reasonable sufficiency. The enterprise introduces all the standards of the quality management system independently. Therefore, it is necessary not to exceed the indicators, but to take into account what they can affect, what to improve, and what to reduce. Otherwise, a situation may occur in which you have a very high-quality product at an unreasonably high price. Moreover, the entire system must be built so as to avoid strong bureaucratization, since it can also increase the time for making an important decision. Formation of a culture in which quality will be the leading goal. Employees must understand without fines and punishments that their goal is to produce high-quality products. The quality control department must educate the staff, why quality management is necessary and that the efficiency of the enterprise depends on each person. Only real facts can create staff confidence in the efficiency of the QMS, in this regard, small victories are also important here: any positive change should be in the context of work in the field of quality management. If the manager publicly touches on all the facts of improving efficiency, quality of activity, combining with the system being built, the likelihood of a unified positive attitude towards the QMS on the part of employees will increase significantly.

Qualified experts in the field of QMS can provide significant assistance to the organization in developing and implementing the quality management system. Their involvement will reduce the time of system implementation, and will also reduce the number of errors and shortcomings that may arise. It is also possible to find new personnel abroad who have extensive experience in quality management or create better conditions for managers from other companies.

Thus, the implementation of a quality management system at an enterprise is a long and labor-intensive process that can pay off with an increase in market share or other economic benefits. This system must be flexible in order to adapt to

changes in time and provide the required level of quality for the end consumer. For quality management, the size of the company does not matter; even the smallest coffee shops can exist by selling good and tasty coffee. A quality management system in action can become an essential tool for continuous improvement of the enterprise, its source of economic benefits. Due to documentation, control, periodic review and analysis of essential production and management processes in relation to the requirements of the international standard ISO 9001, better controllability and continuous improvement of the enterprise are ensured.

If the owner sets the goal of increasing the value of the organization (for sale, attracting investments, capitalization), then obtaining a certificate for a QMS according to the ISO 9001 standard can become an important tool for achieving the goal.

The QMS will give the end consumer a higher level of quality, and this must be done so that he could purchase the product in the future. If a balance point is found and the client is satisfied, he will begin to treat the product more trustingly. And this, in turn, will strengthen the position in the market. Consequently, the competitiveness of the manufactured products increases, since the organization will be able to demonstrate the safety and quality of its production activities, including the purchase of raw materials, production and delivery of products.

The quality management system is used as an effective tool not only for improving the management system, but also for its significant change (reorganization). The process of introducing innovations into the organization is easier: due to the use of the QMS statement as a "legend of changes" when performing the reorganization of the company, a significant reduction in resistance to changes on the part of personnel is achieved.

The benefits that an enterprise receives from having a functioning quality management system (QMS) are as follows:

reduction of ineffective time and material costs. In the conditions of the QMS operation, the name of sub-processes and processes, their duration are well defined, difficult parts of material losses are established, as well as those combined with the reworking of products, time losses;

increasing the quality of services and products. Promotion of the QMS leads to the formation of a management structure for the organization, in which it is beneficial for the personnel to improve and regulate the quality of the services provided and the products manufactured;

modernization of the management system of the organization, its departments. QMS is constantly called the "system of organizational development": the structure of the organization is improved, the distribution of responsibility for achieving planned decisions, for the result of specific coordinated activities of various departments, etc. is specified;

the organization's ability to change the changing needs of the market. Technological clarity, which is provided by the implementation of the QMS, makes it possible to quickly restructure management and production;

increasing staff discipline and responsibility;

gaining loyal customers.

A successfully operating QMS provides predictability to the enterprise, which is understood by clients as part of high stability;

- gaining an advantage over competitors when participating in tenders;
- increasing the image of the enterprise and its authority in the industry;
- access to other export markets;
- a working system for continuous improvement of enterprise processes;
- improving internal interaction within the enterprise, understanding by staff of the organization’s goals, basic principles of work, focusing employees on a single result;
- increase in the market value of the enterprise.

The course adopted in our time in the state on innovative technologies of economic development with support for modern mechanisms of action both in the sphere of management and production, opens up new opportunities for domestic companies and organizations to form competitive products, improve efficient functioning. Transnational experience shows that a systemic solution to quality problems is one of the main factors for the successful implementation of the intended path. Quality management is a young and developing side of management science. Initially, the laid down constructive approach to the creation of theoretical foundations of the quality management system allowed us to go through the technology of modern quality management well and quickly. The model with a successful built-in system of self-improvement and effective implementation of the concept of process and system approaches to management, which has been repeatedly tested in global activity, was set out by the International Organization for Standardization ISO in standards for quality management systems. Being a world federation of national standardization organizations, the International Organization for Standardization ISO on an integrated basis expands the principles of standardization, creates documents necessary for a common understanding of the problem and the development of common solutions.

For the Russian Federation, it is extremely important to develop, implement, and improve the QMS in organizations in accordance with the ISO 9000 series of standards. The ISO standards collect, comprehend, and present in the form of requirements the best practices of various countries in the field of

quality management. These documents are called "best practice". According to domestic experts, the Russian Federation is lagging behind in quality management issues by at least 10 years. The main task that the developers of the ISO 9000 series of standards successfully solved was to develop requirements for the work of the enterprise, the implementation of which indicated the vocation to create products in specific accordance with the requirements of different clients. The ISO 9001 standard (GOST R ISO 9001) "Quality Management Systems. Requirements" is often used in the world and in the Russian Federation for the purposes of QMS certification, which allows the enterprise to receive a good assessment of its merits in the area of quality management at the international and national levels. Work on the implementation of the QMS in accordance with the requirements of the International Standards ISO 9000 series began to be carried out in the country in the 90s of the 20th century by orders of the oil and gas industry and the Government of the Russian Federation. Companies operating in the global market were interested in this. Developments were also made in the industrial and manufacturing sectors, the construction industry. Today, in connection with the administrative reform in the Russian Federation aimed at improving the efficiency of management work in municipal and state administration bodies, a consistent implementation of the most modern management methods in the work of municipal and state authorities has been established. The shortcomings that exist in municipal and state administration are of a system-wide nature, reasonable claims from people to the quality of products force the authorities to think about replacing the bureaucratic system. This is typical not only for Russia.

Today, the world is experiencing a change in the form of governance in the areas of regional, state and municipal governance, and the effective implementation of the QMS guarantees people that their needs and expectations are understood and that there is an opportunity to meet them in a timely and consistent manner. It should be noted that ISO standards for quality systems are provided by methodological recommendations set out in the language "requirements", and each organization implements the requirements of the standard in its work by the most acceptable means. The quality system is established specifically for a certain organization in relation to its goals, objectives, features of the external environment, internal specifics of work and organizational structuring.

Today, the number of Russian enterprises with a certified quality system is less than 3% of the total. At the same time, in Europe and the USA, this share is close to 80%. And yet, what motivates the development of quality management systems in 3% of Russian companies? The motivation for the implementation and improvement of ISO 9000 series standards in the West and in Russia is different, and these differences are quite significant.

Certification for compliance is not a requirement of the ISO series of standards. These standards allow successful application without certification. ISO 9000 standards were planned and accepted by the world community as universal criteria in which the ability of suppliers to constantly produce products that meet consumer requirements is assessed. A huge number of enterprises are certified because they see independent confirmation of compliance, making their contribution to the economic success of the enterprise, to its development. The reasons that motivate Russian organizations to create a certification process according to the ISO 9001 standard are quite diverse. Certification is a powerful marketing mechanism that allows you to increase the image of a company (its products) on the market.

Strict availability of a certificate is a requirement of strategic partners, investors or owners. Working with an organization that has an international certificate according to ISO 9000 series standards is considered the least risky due to the internal structure and orderliness of the company's work, great clarity of the management system, periodic external control by independent registrars. Considering the investment direction of economic policy, one cannot deny the fact that international financial institutions consider certification as a risk reduction for lending and investing. The presence of a certificate plays a key role, since in international practice it is customary to trust organizations that have received a QMS certificate, which determines the image of the company.

In Russia, the share of organizations where a certified quality management system has actually been implemented and produces the corresponding indicators is very small. There are only about 20% of such organizations in Russia out of the total number of enterprises that have a QMS certificate. When an enterprise sets a goal of obtaining a certificate, then, in practice, instead of a quality system, the organization receives a serious "paper-bureaucratic burden" to its main work in the form of many instructions and regulations that are not used in practice. In analyzing the reasons why such a situation has become probable, we will not take into account the obvious positions related to the complexities of the economic situation in the country and the world, the employment of senior management and the lack of necessary knowledge.

Having divided the reasons into external and internal in relation to the organization, we will designate among the external reasons those that are related to the system requirements seen in the ISO 9001 standard, now in the 2015 version. This document has many advantages, but there are shortcomings. I would like to talk about a single

problem - the imperfection of the conceptual approach to the formation of the organization's management system as a system of autonomous systems of quality, project management, built on a common ideology, ecology.

According to the position of the General Director of JSC "VNIIS" in Versana, quality management, ecology and any other work in the organization must be formed in the general process of management of all formed production and economic functions of the organization, differing in their specific goals, tasks. It is the independence of the ISO 9001 standard, to which the producers of this document aspired, that assumes having a system that ensures the improvement of product quality, growth of business data, if the system is implemented, works effectively. It can exist, neither interfering nor helping business structures, if it was not built into the organization's management system when introduced.

Today, it is common to define an integrated management system as a system that meets the requirements of more than several standards (ISO 9001, ISO 14001, OHSAS 18001, SA 8000, ISO 22000, ISO 27001, etc.). This approach turns enterprise managers into certificate collectors. The improvement structure built into the system allows us to think that the integration of the QMS with the organization's management system will occur in the so-called natural way, when documents are clarified and revised, at the stage of quality system analysis by senior management, etc. If these works are not purposefully thought out and planned in advance, the expected accomplishment will not occur.

Implementation with a one-time positive result intended for certification purposes is the correct response of users of quality standards to errors in the basis of the standards.

The ISO series standards are among the most widely used international standards and make a significant contribution to the popularization of quality management worldwide. Today, these standards are used by more than a million enterprises. They have created a basis for developing other standards for management systems: in the field of ecology, health and safety, and information security.

But progress does not stand still, the environment and the methodology of organizations are changing. Therefore, management system standards must be kept up to date. The International Accreditation Forum (IAF) and the ISO Council Committee on Conformity Assessment (CASCO) have established a three-year transition period (from September 2015 to September 2018) from the date of publication of ISO 9001 - 2015. During this time, both standards will be in effect. The transition period will allow users of the standard to introduce changes to their management systems and receive updated certificates of conformity.

In 2017, it was 30 years since the adoption of the first ISO 9000 series standards, including ISO 9001 (then there were three models of requirements for QMS ISO 9001, ISO 9002, ISO 9003). Since 1987, the ISO 9001 standard has become the most successful and widespread standard for management systems (MS) in the history of ISO. ISO series standards are currently used by more than a million enterprises. They created the basis for the development of other standards for management systems: in the field of ecology, health and industrial safety, information security. 15 years is usually the average life cycle of ISO series standards. Therefore, management system standards must be kept up to date. The new ISO 9001-2015 standard is already the fifth version of ISO 9001. Work on revising the ISO 9001 standard began in June 2012 and was completed in 2015. Particular attention was paid to approaches to integrating ISO 9001 and industry standards for management systems - for medical equipment, in the food industry, etc. The QMS development team, as a rule, includes specialists from leading production departments. Employees of the quality department and members of the working group usually undergo training in special programs that consist of ISO 9001 requirements, methods for creating a quality management system and drawing up all the necessary documentation. The creation of the QMS begins with the working group developing a work plan, which must be approved by the head of the enterprise.

The plan specifies the stages and types of work, their deadlines, performers, and, if necessary, the amount of the project. The second stage consists of a comprehensive analysis of the quality management of products or services in the organization and the development of a conceptual model of the QMS. Before proceeding to this stage, it is necessary to analyze the existing management system, identify the weaknesses and strengths of the organization in the area of quality, organizational structure and applied quality control methods.

All departments and services of the enterprise participate in the analysis, and they must provide the quality department with the necessary information within the established time frame. The analysis must be used to determine whether the enterprise documentation is suitable for use in the QMS and meets the minimum requirements. After analyzing the existing enterprise management models, a conceptual model of the quality management system is developed for it. Based on the results of the analysis, a schedule for the development and adjustment of the QMS documentation is carried out. Then, at the third stage, the documentation of the quality management system is developed, which is one of the most important components necessary for the normal functioning of the QMS.

It involves the performance of functions by defining the types and forms of interactions, establishing the order of input and output of

information. Initially, the QMS documentation (according to the requirements of GOST R ISO 9001-2008) included a quality manual, documented information necessary for coordinating various types of activities that were supposed to ensure the effective functioning of the QMS, as well as quality records that confirmed the quality of products, services or works, which contained registered values of controlled parameters.

But the new version of ISO 9001 from 2015 assumes the refusal to use documented procedures, as well as quality manuals. Instead, the enterprise applies various types of documentation. Further, when developing the QMS according to the ISO 9001 standard of the 2008 version and earlier versions, enterprises brought all regulatory documents (job descriptions, regulations on production and functional departments) in accordance with the developed documented procedures and quality manuals.

The head of the enterprise approved the QMS documentation only after it had been agreed upon with all performers. Most likely, when switching to the ISO 9001 standard from 2015, enterprises will adhere to this procedure, since although the amended version of the standard does not require the use of documented procedures and quality manuals, it does not prohibit their use either. Considering that the new version of the ISO 9001 standard from 2015 proposes to use a risk management model, it is necessary to work out, document and monitor all possible QMS risks. The fourth stage requires work related to the implementation of quality management systems. Each employee of the organization can be familiar with the QMS documentation system and trained to work in the conditions of its operation.

The quality service must analyze all deviations from the norm identified during the implementation of the QMS in order to determine the cause of their occurrence and adjust the relevant documentation, if necessary. The quality service also conducts internal audits to establish the operability of the QMS. Thanks to these audits, it is possible to determine to what extent the QMS complies with the requirements of the standard (adequacy check), and how well employees understand and implement the planned activities (compliance check).

The final fifth stage consists of work related to QMS certification. After receiving judgments on the documents of the quality service, this service includes the relevant adjustments and determines the date of the external audit in the organization. After eliminating various inconsistencies, a certificate of conformity is issued for a period of three years, during which the certification body supervises the activities of the QMS in the organization, conducting inspection control every year. If serious violations are detected, the certificate is suspended.

The key changes made to the new version of the standard compared to ISO 9001-2008 are as follows: The structure of the ISO 9001-2015 standard has been changed. In the new version, the number of sections has been increased to ten.

This is done to ensure compatibility of various management system standards. All management system standards have the same system with common section titles. Such a structure is specified by the "Annex SL model". The purpose of creating a common structure of management system standards is to change the application of integrated systems (such as ISO 9001, ISO 14001, ISO 27001, ISO 22301). Exit from classical corrective and preventive actions. Then the new version of the ISO 9001-2015 standard sets the task of applying the risk management model in the organization. Such a model is more general than the strict set of actions specified in ISO 9001-2008 (in the corrective and preventive action sections). Enterprises can use the ISO 31000-2009 standard (Risk management - principles, guidelines) as risk management. Using the concept of "organization context".

The use of this concept assumes a broad framework for the impact of the quality management system. The latest version of the standard requires enterprises to take into account many factors that affect the system, as well as its sustainability. Any organization depends primarily on external factors such as procurement, materials, energy use, the environment, etc. Internal factors (organizational discipline, corporate culture, etc.) also have a significant impact on the activity of the quality system, as well as the organization as a whole. These factors must be taken into account when planning, creating, and operating the quality system. Translation from the concepts of "document" (ISO 9001-2008 pp. 4.2.3), "record" (ISO 9001-2008 pp. 4.2.4) to the concept of "documented information.

This transition allows to move away from the use of documented procedures, quality manuals. The latest version of ISO 9001:2015 will not require such documents. Instead, the enterprise can use different types of documentation (these can be paper, electronic documents, video, sound recordings). The changes affected the basic principles of quality management. Instead of 8 principles, 7 remained, the principle of "Role of Management" turned into "Leadership", the principle of "Systematic Approach" was canceled, the principle of "Mutually beneficial relationships with suppliers" acquired a broader meaning and became known as "Stakeholder Relationship Management".

When forming the latest version of ISO 9001, a "high-level structure" is used, it requires that the content of the standard be divided into ten sections. "High-level structure" uses a separate management cycle, and when applied rationally, it provides self-development of the system. The main focus in the new version of GOST R ISO 9001-2015 is on the effective operation of the enterprise, as well as risk management.

Firstly, the main principle of the document has changed. Now it is not the requirements for the development and implementation of the quality management system, it is a document dedicated to the formation of a commercial management system.

Secondly, the newest standard increases the emphasis on the position of the manager. The implementation of the ISO 9001 standard of earlier versions is full of various examples of insignificant attitude of the top management. Very often, the problems of the quality management system were transferred to low management levels, without certain powers, as well as due support. It is also obvious that large projects without top people will not be able to be successfully implemented. Since personnel is the main resource that gives success, competitive advantages. The manager must be not only the top manager, but also a leader who is able to reveal, and also fully use the creative potential of the staff. The section in ISO 9001, which was previously called "management responsibility" is now called "leadership". It is interesting that in the new standard the concept of "Management representative" has dried up, since any top manager will be personally responsible for the results of his work in the QMS.

Thirdly, the concept of "documented information" has been introduced, which combines the previously used concepts of "documentation" and "records". The new standard excludes the terms: "Quality Manual", "Documented Procedures". Documented information can be stored on any medium (paper or electronic, as decided by the organization).

Fourthly, the newest standard includes 69 new definitions and terms.

Fifthly, the latest version is considered to conduct risk assessment, make decisions based on the results of such assessment. All work of the enterprise includes various risks. Risk is the impact of the unknown on the goals of the enterprise. Risk management is a coordinated work on the management and direction of the enterprise in conditions of risk. Risk management helps people to implement decisions, form an informed choice, create a priority of activity, choose the method of the result of the task. The implementation of technologies, methods of risk assessment provides the ability to effectively implement preventive procedures, improvement activities. The latest version of the standard drew attention to the issue of the relationship of the quality management system with the enterprise management system in general. The quality management system must fully fit into the unified management system, be formed according to general principles, while having full meaning to motivate a thoughtful boss ("the right manager") to apply the principles of ISO 9000 series standards to improve the management of the enterprise in general.

When transitioning to a new standard, the level of changes required for each enterprise will depend on:

From the degree of development, results of the existing management system;

practitioner;

organizational structures.

It is also recommended to conduct an impact analysis of the discrepancies to resolve the required resources and time.

With the latest version of the standard, enterprises with a quality management system must:

Initialize the company's inaccuracies that need to be addressed in order to meet the latest requirements. Form a plan for introducing the latest version of the standard.

To formalize the training and familiarize the personnel.

Ensure that the existing quality management system is relevant, i.e. that it is consistent with the new revised requirements and provides verification of the results.

Where applicable, establish and maintain contact with the Certification Body regarding the implementation of procedures for the transition to the new standard.

Thus, the process under consideration is universal. It can be used at various enterprises, taking into account the specifics of the manufactured products. The implementation of a quality management system at an enterprise makes it possible to accurately determine all the strengths and weaknesses in the management of the organization, the possibility of constant growth and development, as well as improving the quality of products or services produced by the organization. When switching to the new version of the ISO 9001 standard, the 2015 version, the standard model for developing the QMS will also change, it will be supplemented with risk management, instead of standard preventive actions. At present, even a slight increase in the quality of products over similar products of competitors entails the attraction of a large number of consumers to their goods. This makes the development and implementation of a quality management system even more necessary and important processes for the normal development and functioning of any organization.Techmash Plant LLC was founded in 2004 in Shakhty, Rostov Region. Today, it is an actively developing enterprise in the mechanical engineering industry. It manufactures continuous transport machines (conveyor-transport equipment), agricultural tillage equipment, equipment for transporting, storing and processing grain products (elevators, sugar factories), and profile pipes. Our equipment is intended for agriculture and various industries: food, processing, metallurgy, mining, etc.

The main principle of work of Techmash Plant LLC is the production of high-quality machinery and equipment that meets modern requirements; an

individual approach to solving non-standard customer tasks.

Since 2005, Techmash Plant LLC has been one of the main largest suppliers of components for the assembly of combines of Rostselmash OJSC with a supply volume of 20-30 thousand parts per month. In 2013, the company's activities were expanded: a line for the production (rolling) of straight-seam steel profile pipes was launched.

Currently, the company's production capacity is:

- more than 60 units of equipment (including those with numerical and digital control);
- more than 6000 sq.m. of production space;

The employees of Techmash Plant LLC are professionals in their field: highly qualified engineers and designers, technical specialists.

The plant is working on creating new models of tillage units, modernizing the equipment it produces, and closely cooperating with leading agricultural enterprises in the south of Russia.

The buildings in which the enterprise is located comply with technical and technological requirements. Technological requirements facilitate the creation of such production conditions that allow the placement of technological equipment, ensure the movement of materials and equipment during its installation and dismantling. Technological requirements cover issues of strength, durability and fire safety of buildings.

The enterprise's workshops are located in a two-story building. There is a mechanical workshop, a welding structure workshop, as well as a finished goods warehouse and a warehouse for raw materials and auxiliary materials.

The organizational structure of management is presented in Figure 1.

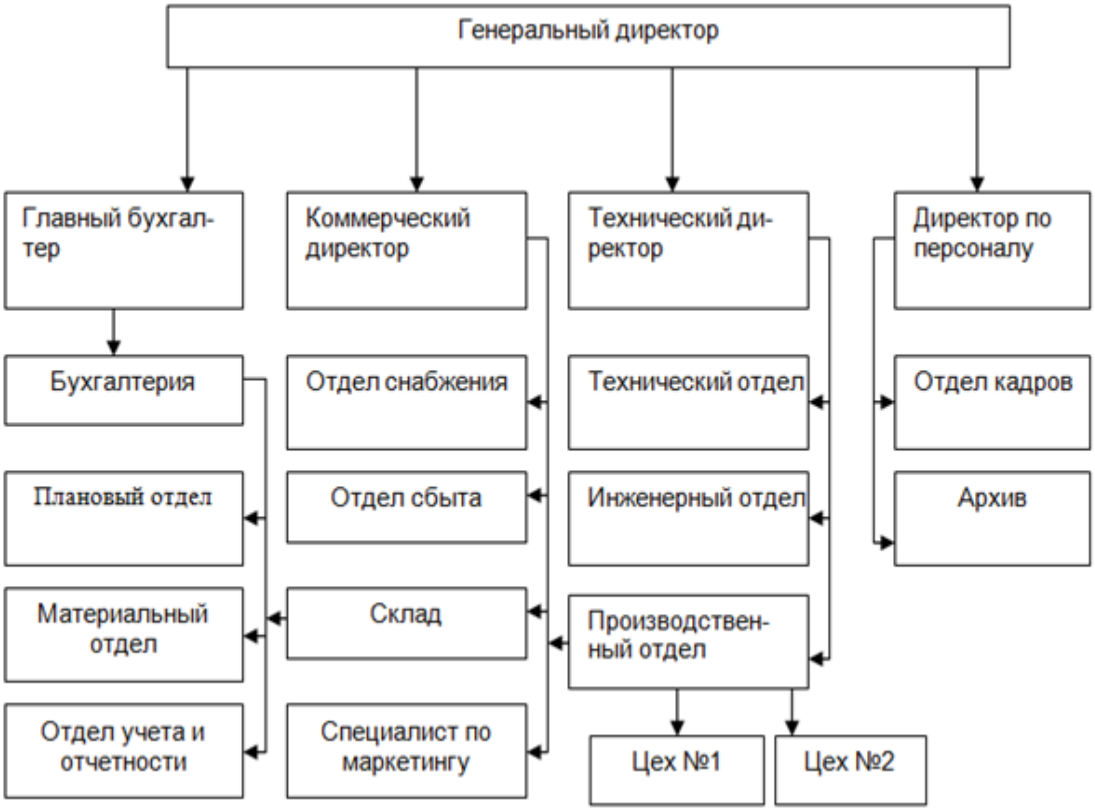

Figure 1 – Organizational management structure of Techmash Plant LLC

The CEO is the main responsible person of the enterprise and is responsible for making the vast majority of decisions regarding the functioning of the company.

The chief accountant is an official of the enterprise who ensures the organization of accounting, control and reflection in the accounts of accounting of all business transactions carried out by the enterprise, institution, provision of operational information, preparation of financial statements within the established timeframes, implementation, together with other divisions and services, of economic analysis of the financial and economic activities of the enterpriseits development.

A supply manager is an employee who supplies the company with products. He or she is a managerial position.

Technological department - is a division responsible for the company's technological resources. The HR department is a set of specialized divisions in the structure of the enterprise (with officials employed in them - managers, specialists, technical personnel), called upon to manage the personnel of the enterprise.

Marketer – is a specialist who studies market demand and supply for certain goods and services.

CNC machine operators - control of the process of processing parts, monitoring of machine operation, correction of control programs.

Turner- machine operator, specialist inturning—cutting processing rotating workpiecesorrotating cutting tool, for processing wood, metal, plastic, etc.

Milling machine operator-worker, specialist in milling machine operations, specialist in processing various materials: metal, wood, plastic. This profession is one of the most leading working professions in mechanical engineering and metalworking.

The plant produces continuous transport machines (conveyor-transport equipment), agricultural tillage equipment, equipment for transportation, storage and processing of grain products (elevators, grain processing plants, sugar factories), and profile pipes.Figure 2 shows the range of products manufactured.

Figure 2 - Double-row disc harrow

Figure 3 - Four-row disc harrow

Figure 4 - BDS garden disc harrow

Figure 5 - KPO cultivators

RFigure 6 -Universal stubble cultivator

Figure 7 - Binary-share plow

Figure 8 -Inter-row cultivator

Figure 9 - BMR rotary harrow hoe

Figure 10 - Disc mulcher DM

Characteristics of the model shown in Figure 10: BDM disc harrows are designed for traditional and minimal primary and pre-sowing tillage of soil for grain, industrial and forage crops, refreshment of sodded meadows and stubble cultivation.

In one pass, the harrow crushes and incorporates the plant residues of the predecessor and weeds into the soil, creates a loosened and leveled soil layer, and incorporates the applied fertilizers.

Each disc has the ability to adjust the angle of attack and the working width of the disc. The disc acts as a ploughshare and a mouldboard, which contributes to a better turnover of the cut layer, its crumbling, and also to a reduction in the required traction force of the tractor. The absence of disc batteries with a single axis in the design allows the BDM to work in wet weather on lands with a large amount of plant residues, as well as on lands with any amount of weed vegetation, while eliminating winding on the disc axis and dense clogging of the disc rows. There is no need to use scrapers in the design, since the disc self-cleans during operation.

The BDM is of particular value in areas of small area and complex terrain, where greater maneuverability of the unit is required.

The design for gardens and vineyards allows for the combination of three tools in one type, differing in the width of the processed strip in increments of 275 mm.

Table 1 shows the technical characteristics of the disc harrow.

Table 1. Technical characteristics of the disc harrow

Names	Units of measurement	Values
Type		Trailer
Productivity for an 8-hour shift	ha	30
Working speed	km/h	8-15
Transport speed	km/h	No more than 25
Soil moisture	%	Up to 35
Width of capture	mm	3200
Weight	kg	2600
Dimensions		
- width	mm	3200
-height	mm	1350
- length	mm	2550
Number of cutting units in one row	pcs.	8(7)
Cutting units in total	pcs	30
Number of rows	pcs.	4
Diameter of working parts	mm.	560
Distance between disks	mm	400
Distance between rows of disks	mm	700

Angle of attack of discs	hail	From 0 to 30
Processing depth	cm	Up to 15

Figure 11 shows the Cutting Unit.

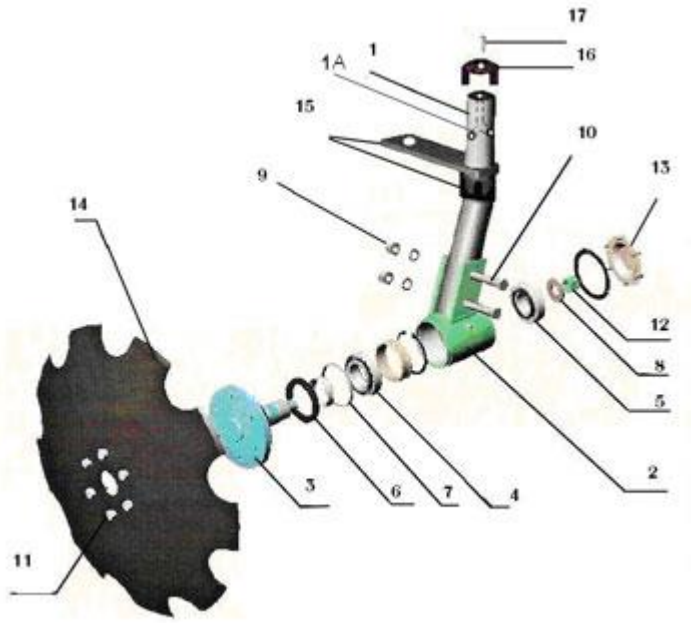

Figure 11 - Cutting unit

The cutting unit is designed for undercutting, chipping and turning the formation. It is the main working element of the tool (Figure 11). It consists of a stand 1, to which the bearing unit is attached with two bolts and nuts 9,10. The bearing unit consists of a bearing housing 2, which has a grease nipple, bearings 4,5, cuff 6, axis 3.

The bearings are adjusted via a washer 8, a crown nut 12, which is secured with a cotter pin. The housing is protected from dirt by a cover 13. The cutting disc 14 with a diameter of 560 mm is attached to the axle with six bolts 11.

The rack is welded to the bushing with a rotary bar 15 to reduce the load by a transverse seam. The rack has three through holes 1A in the upper part for additional lubrication, which is carried out through a threaded hole for bolt 17. All bearing units are filled with Litol 24 plastic grease.

The organization and implementation of technical quality control are one of the constituent elements of the quality management system at the stages of production and sales of products.The process of interaction of production factors at an enterprise, aimed at converting raw materials (materials) into finished products suitable for consumption or further processing, forms the production process or production.The main requirements for the quality of manufactured products are established by state standards. They set out the requirements for the main parameters and dimensions, surface treatment quality, and design of products. The standards regulate: alloy grades used for manufacturing. Metal grades recommended as the main coating, thickness of the base metal and coating; surface roughness parameters of the product. The standards contain strength requirements and set out the principles of acceptance. Defects in appearance, the degree of their permissibility in products depending on the type and quantity, size, location of defects, and the total surface area of the product are indicated. The standards also set out acceptance rules and testing methods. They regulate the requirements for packaging, labeling, transportation, and storage of finished products.

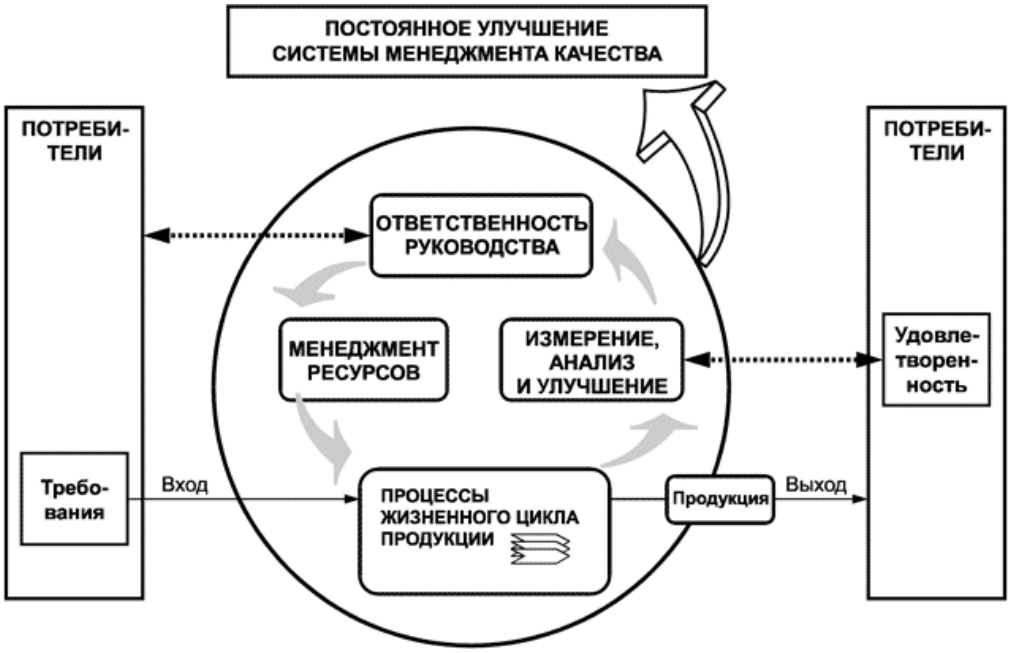

Figure 12 – Process model

As can be seen from the process model, there is a constant improvement in product quality due to consumer requirements and management responsibility. Products go through all stages of the life cycle and their quality is constantly improved due to corrective actions as a result of identified nonconformities that are identified by the quality service. If the product does not satisfy consumers, it is measured, analyzed and improved to meet consumer requirements. The management system of Techmash Plant LLC, including a quality management system based on the requirements of ISO 9001:2015, an environmental management system based on the requirements of ISO 14001-2014 and an occupational health and safety management system (OH&SMS) based on the requirements of OHSAS 18001-2007, was developed and implemented in 2017 - 2018. The integrated management system is shown in Figure 13.

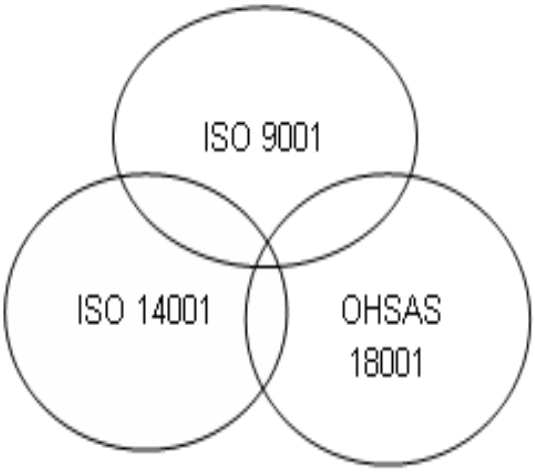

Figure 13 – Integrated management system

The similarity of the structures with the requirements that make up the QMS allows us to identify certain common elements of these management systems: common elements: management representative for the QMS; management responsibility; QMS policy; resource management; QMS management; common processes: QMS analysis by management; decision-making and actions by top management; planning, development and implementation of strategic activities in the area

of meeting customer requirements; design and development; procurement; production and servicing;

unified procedures: documentation and records management; internal audit of the QMS; monitoring and measurement of processes.

Certification of the QMS for compliance with the requirements of international standards allows to increase the competitiveness of the organization, to assure interested parties of the effectiveness of the organization's solution to the problems of environmental and industrial safety of the relevant industries, problems of labor protection and safety engineering.

In order to inform employees about the established requirements and planned activities within the framework of the plant's QMS, documentation has been developed and is used. Documentation management is carried out in accordance with STO QMS 1-04-2011 "Documentation Management". The structure of the QMS documentation consists of 4 levels.

Level 1 contains documents:

quality, environmental and occupational health and safety policies, statements of objectives in the areas of quality, environmental and occupational health and safety management;

programs;

QMS manual;

Level 2 contains documents:

documented procedures, the need for which is established by ISO 9001 and procedures required by ISO 14001 and OHSAS 18001 – STO ISM (STO QMS, STO SEM, STO SMPSiB);

external regulatory and technical documentation (GOST R, GOST, OST, TU, etc.).

Level 3 contains documents:

regulations on structural divisions;

job descriptions;

work instructions, TI (technological instructions), PTI (production and technical instructions), IOT (labor protection instructions);

TU developed by OOO Zavod Tekhmash and other internal regulatory and technical documentation developed in accordance with ESKD (Unified System of Design Documentation) and ESTD (Unified System of Technological Documentation);

organizational and administrative documents on QMS issues.

Level 4 contains the records necessary to demonstrate conformity with the QMS requirements, as well as records of the results achieved.

QMS Manual – this document containing a description of the scope of the QMS, a general description of the elements of the occupational health and safety management system, environmental management system, quality management system and their integration, as well as documented procedures required by ISO 9001, ISO 14001, OHSAS 18001.

The QMS Guide is applied within Techmash Plant LLC to ensure the effective functioning of quality management systems in accordance with the requirements of ISO 9001, ISO 14001, OHSAS 18001 and to present the QMS to all interested parties outside Techmash Plant LLC.

The QMS manual is developed by the USM, signed by a representative of the management and approved by the managing director of Techmash Plant LLC.

The control copy of the QMS Manual is stored in the USM. The registered copies are issued according to the "List of holders of the "QMS Manual", registered and managed in accordance with STOSMK1-04-2011 "Documentation Management". Access to the electronic version of the document is provided when the Company's QMS Manual is posted on the portal of Techmash Plant LLC.

When replacing, adding or excluding individual requirements, a change is made to the Quality Management Manual.

When making changes, the same procedures and rules are applied that are used when developing the QMS Manual. Changes made to the text are highlighted in italics. After each changed or new section, subsection, clause, subclause, appendix, information about the change(s) made is given in brackets in bold italics, indicating its number(s).

The main objective is to produce products that meet the requirements and expectations of consumers, in safe and accident-free conditions for personnel and all interested parties with an acceptable impact on the environment.

The main principles of OOO Plant "Techmash":

all accidents and incidents can be prevented;

no work should be started unless it can be done safely;

admission to work at hazardous production facilities only of persons with appropriate qualifications;

leadership management;

personal responsibility;

systems approach to management;

partnership with all stakeholders;

risk management approach;

rational use of resources;

staff involvement and continuous training;

continuous improvement.

The management of OOO Zavod Tekhmash undertakes the following obligations:

ensure continuous improvement and enhancement of the effectiveness of the integrated management system of Techmash Plant LLC in the field of labor protection, industrial safety, ecology, quality in accordance with the requirements of OHSAS 18001; ISO 14001, ISO 9001, legislative and other requirements applicable to the company's activities;

comply with the requirements of the integrated management system of LLC

Techmash Plant, as well as legislative and other requirements related to the products, environmental aspects and risks of the Company in the field of labor protection and industrial safety;

ensure the creation of safe and accident-free working conditions aimed at preventing accidents, incidents, industrial injuries and deterioration of workers' health;

ensure conditions for the safe operation of hazardous production facilities to reduce the risk of accidents at hazardous production facilities;

conduct consultations with employees and their representatives on issues of ensuring labor protection and industrial safety;

prevent negative impacts on the environment.

The management of OOO Zavod Tekhmash assumes responsibility for the implementation of the Policy and provision of the necessary resources for the effective functioning of the integrated management system.

All personnel of the company participate in the implementation of the policy, and each employee must understand how his actions can affect:

your own safety and health;

the safety and health of others;

industrial safety;

quality of manufactured products;

the environment.

Monitoring and measurement of products includes:

incoming inspection of raw materials and supplies;

quality control and testing of products during the production process (operational control);

operational control;

acceptance control;

final inspection of finished products (for the construction rolling site);

quality assurance control during intra-shop transportation, storage and shipment.

Incoming inspection is a quality check of raw materials and auxiliary materials entering production. Constant analysis of the quality of supplied raw materials and materials allows influencing the production of supplier enterprises, achieving quality improvement.

Measures for control or other activities necessary to ensure compliance of purchased products with the requirements specified in the procurement information are defined in STO QMS 5-11. Product quality control during production includes all types of control and testing of products performed during the technological process (operational control). Compliance with production technology is a necessary condition and basis for ensuring the specified quality of manufactured products. Control over compliance with technological discipline is multi-stage and is divided into:

continuous;

periodic;

extraordinary

A brief description of the types of control over compliance with technological discipline is given in Table 2.

Monitoring and measurement of technological processes is carried out as a result of operational control and control over the implementation of technological discipline.

Operational control of production technology is carried out by the technological personnel of the workshops and the quality control personnel.

Table 2. Characteristics of types of control

Type of control	Step No.	Control Executor	Periodicity	Scope of control
Continuous	I	1. Worker, foreman, quality control inspector	During the shift	Execution of operations at workplaces in In accordance with technology Documentation and control scheme.
Continuous	II	1. Shift supervisor, shift production foreman and quality control foreman, senior production foreman, site manager	During the shift	Compliance with production technology, quality of products and materials used, knowledge of regulatory and technical documentation by 1-2 workers.
		3. Head of the division and quality control department, production foreman and quality control department foreman.	Weekly	Analysis of product quality.

Periodic	III	Subdivision commission (shop)	Once a month according to the schedule	In accordance with the requirements of clause 6.3 of this STO
Periodic	IV	Society Commission	Once a month according to the schedule	In accordance with the requirements of clause 6.3.1.2 of this STO
Extraordinary	V	A commission appointed by the senior management of the Company	At the direction of the senior management of the Company	In accordance with the requirements of section 6.4 of this STO

During operational control, compliance with the requirements of process instructions, standards, technical conditions and other regulatory documents is checked in accordance with the production technology and product quality control scheme, hereinafter referred to as the control scheme, ensuring continuity of control at all stages of production. The results of operational control are recorded by the quality control inspector or the workshop employee (in the case of self-control) in logs or other documentation specified in the process instructions and the control scheme. Records of the results of operational control are kept in accordance with STO QMS 1-03 and must contain the achieved results or evidence of the activities performed.

The first stage of control is carried out by workers, foremen, and quality control inspectors.

Control is carried out directly at the workplaces during the shift. The results of control are recorded in logs, passports, and protocols. Records on the results of technology control are kept in accordance with STO SMK1-03.

Second-level control is carried out by senior and shift production foremen, quality control foremen, heads of department sections and quality control. Control is carried out on a shift/weekly basis.

During the control process at the second stage, the personnel's compliance with production technology, the quality of products and materials used, and knowledge of regulatory and technical documentation requirements are checked.

Periodic monitoring includes the third and fourth stages.

The third stage is carried out by the commission of the production unit (shop).

Control is carried out once a month according to a schedule approved by the head of the department by a commission consisting of:

Chairman - Deputy Head of the Shop (Chief Specialist);

members - head of the area being inspected;

representatives of the quality control department, laboratory in the area, technological service. By decision of the chairman - representatives of mechanical/electrical/energy services.

Based on the results of the commission's work, an order is issued for the division, which reflects:

All identified discrepancies with an indication of the timeframes for their elimination and the executors.

Based on the decision of the chairman of the commission, design documentation is developed for non-conformities affecting the effectiveness of the quality management system in accordance with STO QMS 5-05.

The deputy head of the workshop prepares the commission's work schedule and orders based on the inspection results.

The assignment of responsibilities for performing this work to another manager is formalized by an order for the division.

The fourth stage is carried out by the Society's commission.

Control is carried out once a month in one of the divisions. The results of control are formalized in a report, which is signed by the members of the commission and approved by the chief engineer. The technological service prepares a schedule for checking compliance with production technology by the Company's commission and reports on their results. Based on the identified nonconformities, measures are developed to eliminate them, indicating the deadlines for elimination and the executors. The chairman of the commission determines from among the identified nonconformities the points that require determining the causes of their occurrence and developing corrective actions to eliminate them. The head of the inspected division is responsible for developing corrective actions; the development of corrective actions is formalized as an appendix to the report in the form of a table and sent: the original to the chairman of the commission, copies to: the deputy chief engineer for technology the head of the technical department of the Company no later than 15 days after receiving the report. One copy is kept in the division together with the Report.

Control over the implementation of measures to eliminate identified nonconformities and corrective actions is carried out at quality meetings with

department heads with a note in the meeting minutes.

The heads of departments provide information on the implementation of measures to eliminate identified non-conformities and corrective actions as appropriate in the TU/TO RMK (copies of protocols, letters).

The fifth stage is extraordinary control, carried out at the direction of the Company's management.

The basis for conducting an extraordinary inspection of compliance with production technology are non-conformities identified in technological process that require a collective decision by specialists from different departments (for example, mass production of non-conforming products).

The commission is headed by the chief engineer. The commission includes: the head of the technical department of the Company, chief specialists in the areas, at the request of the chairman other persons may be involved in the commission.

The results of the inspection are formalized by order of the General Director of OOO Tekhmash Plant.

Control over the implementation of measures to eliminate identified non-conformities and corrective actions is carried out by members of the commission and, if applicable, by the TU/TO RMK.

Acceptance control of products is carried out by employees of the quality control section of the relevant workshop, by employees of the workshop conducting the technological process, if this is provided for by the control scheme, in order to obtain evidence that the products have passed and withstood all the provided types of control and testing. To carry out acceptance control, the results of testing samples (specimens), as well as measurement and visual inspection of the appearance and quality of the surface are used.

Acceptance of products is processed by the Quality Control Department employees (in divisions transferred to self-control - the executor of the technological process) and is registered in the forms of records of the established sample, provided for in this process stage (passport, process chart, invoice, entry in the journal, rack list).

During the final inspection, conformity assessment of the products is carried out, by means of which the manufacturing division ensures and declares that the controlled products meet the requirements applied to them. Products manufactured in accordance with the requirements of regulatory documents and technical documentation, agreements (contracts), which have passed all types of control and testing with positive results, are submitted for final inspection.

The documents for presenting products to the Quality Control Department for final control are internal workshop invoices, cards for finished products, reports on production operations and other documents specified in the process instructions.

If the results of all types of control and testing of finished product parameters for compliance with the requirements of regulatory documents and technical documentation, agreements (contracts) and terms of the work order are positive, the control foreman or the person responsible for control gives permission for the shipment of products with the execution of the established technological documentation.

The products may not be sent to the consumer until the procedures provided for in the control schemes and ND have been carried out with satisfactory results, and until the relevant data and documentation have been presented for certification.

If any non-conformity is detected during product inspection, the control foreman or the person responsible for inspection takes measures to organize the elimination of the non-conformity. Further actions with such products are carried out in accordance with STO QMS 5-15-12 "Management of non-conforming products".

The procedure for quality control during intra-shop transportation, storage and shipment is carried out in accordance with the production instructions of the departments that carry out loading and unloading operations, storage, packaging and delivery of products in accordance with regulatory documents and contract terms.

In accordance with the requirements of ISO 9001-2008, clause 8.1, the following requirements are specified:

"The organization shall plan, implement the measurement, monitoring, analysis and improvement processes necessary to:

evidence of compliance with product requirements;

establishing compliance of the quality management system;

continuous improvement of the QMS effectiveness.

This work should introduce the definition of important methods, as well as statistical methods, the extent of their application."

The stability of the production technology, as well as the quality characteristics of metal products, is controlled by analyzing the value of intra-melt heterogeneity in accordance with OST 14-1-34-90, as well as by comparing the control sample with their key values, formulated according to the original sample.

The initial data (profile, steel grade, dimensions, sample size, its representativeness, homogeneity) must comply with the requirements of OST14-1-34-90.

The quality level of each batch of melting corresponds to the conditions of the standards and is guaranteed by the production technology, post-operational float control of the technological process, and the acceptance quantity for each quality feature.

The stability of the production technology and product quality indicators are controlled by studying

the degree of intra-melt heterogeneity in accordance with OST 14-1-34-90, comparing the main sample with their initial values determined by the basic sample.

The conclusion on the compliance of the controlled parameters with the conditions of these standards and technical requirements is made by comparing the calculated values of quality attributes with the acceptance figures.

The stability of the quality of metal melting over time is assessed by comparing the average values, as well as the dispersions of the quality levels, data for the control period (according to the data of the quality control systems of raw materials, technological processes, materials, product quality), with their basic values, determined for a specific input sample.

Dispersions, as well as the average value of characteristics in the compared period, may not differ from the main ones by 5% of the degree of significance. An additional criterion for the stability of quality indicators is the degree of intra-melt heterogeneity, which is determined by the magnitude of the range according to OST 14-1-34-90.

Table 3 provides an assessment of the existing quality management system at the enterprise.

Table 3. Assessment of the existing quality management system at the enterprise according to the standard GOST R 9001-2015

Standard point	Name	Note
P. 5.2.	Improving quality policy	The organization has
P. 6.3	Planning for change	It is carried out in accordance with with standard
P. 8.1	Planning and management of activities at stages of the life cycle of products and services	Implemented in accordance with the standard
P. 8.3	Design and development products and services	It is carried out in accordance with with standard
P. 8.4	Management of processes, products and services supplied by external suppliers	Implemented in accordance with the standard
P. 8.5	Production of products and provision of services	It is carried out in accordance with with standard
P. 9.1	Monitoring, measurement, analysis and evaluation	It is being done, but not enough
P. 9.2	Internal audit	There are some shortcomings in Organization of the internal audit system
P. 9.3	Management review	There are problems in the system Control over quality standards

Table 4. Criteria for assessing the effectiveness of management systems based on the results of internal audit

Evaluation criteria	Points
The requirements are met in full.	9-10
Requirements are met, no discrepancies were found, but there are comments	6-8
Requirements are met, no more than 5 non-conformities and/or no more than 3 recurring non-conformities have been identified	3-5
Requirements are not met to a significant extent, more than 5 nonconformities and/or more than 3 recurring nonconformities have been identified	1-2

Thus, the organization has various control methods and quality control techniques. But the following shortcomings have also been identified, such as monitoring, measurement, analysis and evaluation are not fully consistent with the stated requirements; there are shortcomings in the organization of the internal audit system; There are problems in the quality standards control system. In general, the QMS activity can be assessed as good, since the requirements are met, but there are shortcomings.

The presented analysis by the ISM management does not include all the information on the functioning of the management systems:

incomplete input information taking into account the results of the internal audit and the implementation of corrective actions based on the results of the external audit;

there is no complete information on the assessment of compliance, based on the results of interaction with external stakeholders, including complaints;

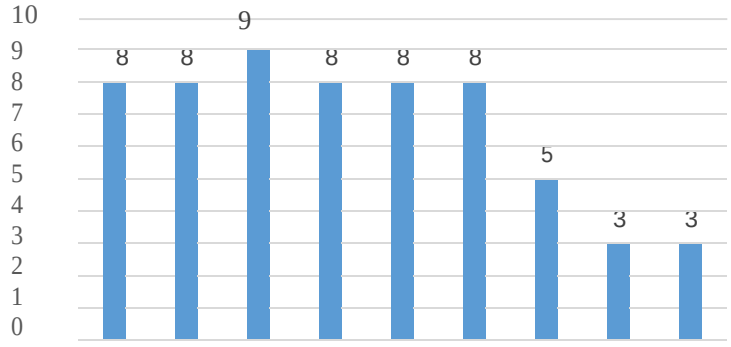

Figure 14 – Diagnostics of compliance with the standard criteria

The presented analysis by the QMS management does not include all the information on the functioning of the management systems: incomplete input information taking into account the results of the internal audit and the implementation of corrective actions based on the results of the external audit; there is no complete information on the conformity assessment, on the results of interaction with external stakeholders, including complaints; there is no information on the QMS of the branches, on the effectiveness of the functioning of the processes, the status of corrective and preventive measures. The non-conformities named above must be corrected by the organization in accordance with the requirements of the standard regarding corrective actions, including an assessment of the causes of non-conformities and measures to prevent their recurrence.

Corrective actions aimed at correcting the specified minor nonconformities should be documented in a corrective action plan and sent to the auditor within 90 days for evaluation. If the corrective actions are assessed as satisfactory, they will be reviewed during the next scheduled audit.

It is advisable to implement a quality management system at the enterprise based on the ISO 9001:2015 series of standards. This will allow:

the means, methods, and goals of management should be oriented towards quality;

to provide an action plan for the enterprise (documentation, compliance with requirements, organization of work of departments and services);

precisely assign powers and responsibilities, regulate interactions between different departments and specialists;

create new requirements for the preparation of quality documentation (rules, instructions, provisions, regulations);

determine the requirements for important processes that affect the QMS, formalize these requirements in the form of documented procedures (enterprise standards, methods, etc.);

focus on preventing errors, adjustments and deviations from the established requirements of the standard;

continuous improvement of the quality of the organization's products, the quality of the activities of all personnel of the organization, reducing losses and reducing the cost of production;

increase the responsibility of all personnel for work results;

reduce non-production costs of time and materials, identify services where material losses occur, including reworking of products and loss of time;

improve the image of the enterprise;

increase the investment attractiveness of the organization;

increase the profitability of the enterprise;

ensure that consumer requirements are met and improve guarantees for them;

the presence of a quality management system, confirmed by a certificate, is a confirmation of the organization's ability to act. Certain problems in the organization of the quality management system in the organization have been identified. Hence, this section will offer recommendations for improving and implementing the quality management system of the new ISO standard at the enterprise. Recommendations for improving the quality management system are presented in Table 5.

Table 5. Recommendations for improving the QMS

Item No.	Recommendations
P. 5.2.	Update the quality policy. Modernize the QMS manual by including the scope of the system and a description of all enterprise processes.
P. 6.3	Update change planning. Amend the Document Management document to include a description of: - management of external and internal regulatory documentation, including Regulations, STP, process instructions, operating instructions, labor protection instructions, regulations on departments, job descriptions. Expand the documented procedure "Records Management" in which to identify the types of records according to the QMS, determine the location, terms of their storage and withdrawal.
P. 8.1	To modernize the planning and management of activities at the stages of the life cycle of products and services. Improve the Quality Policy, establish a procedure for its dissemination to interested parties (staff, external interested parties, including the public, suppliers and consumers of products). Determine the order of changing the goals in the field of MC. Change the procedure for developing Quality Objectives, in accordance with which documented objectives must be adjusted for each division.
P. 8.3	Improve the design of products and services. Upgrade and maintain the instrumentation management procedure.
P. 8.4	Improve the management system for processes, products and services supplied by external suppliers: 1. In order to improve the planning process, develop a procedure for quality planning. 2. Update activities to improve product quality. Improve the procedure for analyzing questionnaires to assess consumer satisfaction.
P. 8.5	Improve the production of products and provision of services. Develop a procedure describing the process of managing nonconforming products. Adjust the document describing the storage conditions for finished products. Responsibilities and authorities in the QMS shall remain the same, with their inclusion in the Regulations on departments, job descriptions and work instructions. Bring to the attention of personnel against signature. Reassign the representative of the enterprise management and define his main duties and powers in the QMS in accordance with the new standard. Taking into account the number of personnel of the enterprise, it is recommended to appoint a group of responsible specialists consisting of at least 5 people for the development and further maintenance of the System in an effective state. Determine the requirements for personnel competence in accordance with the QMS requirements. Appoint representatives and improve the position of personnel in the QMS, including their rights, duties and responsibilities). Include topics related to the requirements for transition to the new international standard ISO 9001:2015 in training programs.
P. 9.1	Implement improvements in monitoring, measurement, analysis and assessments.
P. 9.2	Correct deficiencies and improve the internal audit of the organization
P. 9.3	Conduct management reviews on a periodic basis. 1. Improve the procedure for conducting QMS analysis by senior management. 2. Establish more stringent criteria for top management review in accordance with ISO9001-2015 requirements.

OOO Zavod Tekhmash is a leader in the supply of a number of types of metal products for construction and structural applications. The plant constantly improves the effectiveness of the QMS by applying policies, goals in the field of professional health, data analysis, as well as safety, quality, ecology, audit results, corrective, preventive actions, and QMS analysis.

At the largest enterprises, such as OOO Zavod Tekhmash, quality, ecology, and labor safety are inseparable parts of management. Management systems are becoming increasingly necessary for enterprises striving to become competitive at the global level. Certification of the QMS for compliance with the conditions of international standards makes it possible to increase the competitive advantages of the enterprise, to prove to interested parties in the effective solution of the enterprise's problems of environmental, industrial safety of these industries, labor protection problems, as well as safety engineering.

Table 6. Analysis of changes to the ISO 9001-2015 standard

ISO 9001-2011	ISO 9001-2015
0. Introduction	0. Introduction
1. Scope	1. Scope
2. Normative references	2. Normative references
3 Terms and definitions	3 Terms and definitions
4. Quality management system	4. Organization environment
5. Responsibility of the parties	5. Leadership
6. Resource management	6. Planning
7. Release of products	7. Means of support
8. Measurement, analysis and improvement	8. Activities at the stages of the life cycle of products and services
	9. Evaluation of performance results
	10. Improvement

A comparison of the old and new standard shows the following data:

the applications remained the same (approval sheets);

the content of the sections has changed (1 Scope. 2 Normative references. 3 Terms and definitions. 4 General provisions. 5 Planning internal audits. 6 Sequence of work during internal audit. 7 Responsibility.) – as you can see, the volume of these sections has decreased. Additional procedures have been reduced, thus the goal was to simplify internal audit procedures in order to more quickly identify the root causes of problems and develop corrective actions.

As part of the transition to the new version of the ISO 9001-2015 standard, OOO Techmash Plant needs to pay attention to the following aspects in the field of documentation:

In the ISO 9001-2015 standard, there is no longer a distinction between the concepts of “document” and “record”, and the term “documented information” is used instead;

The new version of the standard no longer uses the concepts "documented procedure" and "quality manual";

The ISO 9001:2011 version of the standard does not clearly specify the requirements for storing and protecting documented information; in the new version of the ISO 9001-2015 standard, these requirements have been explained in more detail.

Thus, at present, OOO Zavod Tekhmash has implemented and documented a quality management system (QMS) in accordance with the requirements of the ISO 9001:2008 standard. The QMS is maintained in working order and is constantly being improved.

Let us take a closer look at the documented information management process implemented at OOO Zavod Tekhmash as part of the transition to the new version of the ISO 9001-2015 standard. Currently, the documented information of OOO Zavod Tekhmash includes the Quality Manual, procedures, reporting forms/instructions, and accounting records. The following types of documents are considered internal documented information of the organization:

level 1 – documented Mission, Vision, Policy and Objectives in the field of quality, Quality Manual;

level 2 – organizational standards, regulations, job descriptions;

level 3 – documents on planning, implementation and management of QMS processes;

level 4 – records.

At OOO Zavod Tekhmash there are three types of internal documented information:

Documented information registered by the quality control service and having registered copies

(Quality Manual, organization standards, regulations). This documented information is managed in accordance with clause 5.1.1 of ISO 9001-2015;

Documented information related to the scope of activities of a specific structural unit and stored in it. This documented information is managed in accordance with clause 7.5.3.2 of ISO 9001-2015;

Documented information in free circulation, i.e. the effect of copies of which is equivalent to the original document (Quality Policy, regulations). This documented information is not subject to change, is cancelled by order or regulation, and is also replaced by a new document.

The requirements of the internal documented information of the quality management system should not contradict the requirements of external regulatory documents. External documented information includes regulatory and legal documents developed by external organizations, the requirements of which relate to the scope of application of the QMS of Techmash Plant LLC. The requirements set out in the external documented information are mandatory for execution. The following types of documents belong to the external documented information of the QMS of Techmash Plant LLC: laws, regulatory and legal documents of the President and the Government of the Russian Federation, regulatory acts of federal executive bodies of the Russian Federation, constituent entities of the Russian Federation and local governments (basic level).

In conclusion, we can draw conclusions on improving the quality management system to the requirements of the new ISO 9001:2015 standard at the enterprise:

identification of problems, the elimination of which will facilitate compliance with the new requirements of the standard;

It is recommended to appoint a group of up to 5 people from the enterprise (the department for quality management and control of the QMS) responsible for improving the QMS to meet the requirements of the new standard;

appoint the Deputy General Director for Quality as the responsible manager of the work on the transition to the ISO 9001:2015 standard in the organization;

change the responsibilities of personnel responsible for quality control;

develop a plan and schedule for improving the QMS at the enterprise;

improvement of QMS documentation;

analysis of proposals for improving the QMS;

elimination of non-conformities with the new standard;

ensuring training for all personnel who influence the organization's results in the new requirements of the standard;

definitions of organizational knowledge;

production of internal audit;

analysis of activities by senior management;

preparation for certified audit;

conducting certification at the enterprise.

As the analysis of the current standard showed, OOO Zavod Tekhmash has a problem in identifying the root cause and developing corrective actions for non-conformities identified in the divisions of the organization. Therefore, it is proposed to improve the current quality management system from the standpoint of improving the procedure for conducting an internal audit of the QMS documentation.

It is proposed to leave the supporting documentation as is - the Guide to the integrated management system in the field of occupational health and safety, ecology and quality of Techmash Plant LLC, the Regulation on the management of management systems, but it is proposed to update them - that is, sign them according to the current date.

Three years are given to implement all the requirements of ISO 9001-2015. During this transition period, certification can be carried out both according to the 2008 version and according to the new version.

Quality Management System Improvement Program:

The first stage is organizational;

Stage two – implementation of elements of the new version of the standard;

Stage three – conducting internal audits of the quality system, monitoring the work performed.

To implement the improvement stages, it is necessary to create the necessary conditions in the organizational structure, as well as in the resource and methodological ones.

Persons who will be responsible for organizing and implementing work to improve the quality management system must be delegates top and middle management.

It is necessary to define the goals, objectives, and basic principles of the new quality management system to all personnel. The absence of explanatory talks and training may lead to a decrease in results, in this regard, it is important to involve all personnel in the process of improving the QMS.

Table 7. Schedule for improving the quality management system

Event name	Number of days	Responsibility for implementation and control	Completion dates
Creating a working group	3	First Deputy General directors - quality director	3.04.2023-5.04.2023
Work planning	5	Quality Council	6.04.2023 -10.04.2023

Preparation and holding of meetings to assess the QMS	5	Head of Service Quality control, chief engineer	11.04.2023 –15.04.2023
Customer and client satisfaction surveys	7	Assistant to the General Director for Public Relations	16.04.2023 – 22.04.2023
Analysis of needs of clients, staff, suppliers, etc.	3	Head of Quality Control Service, PRK	23.04.2023 – 25.04.2023
Analysis of the current QMS	4	Quality Director, Head of Quality Control, Chief Engineer	26.04.2023 – 29.04.2023
Analysis of proposals for improvement	3	Head of Quality Control, Chief Engineer	30.04.2023 – 2.05.2023
Improving the Change Management and Analysis Plan	5	Head of Quality Control Service	3.05.2023 – 7.05.2023
Updating the Risk Response Plan	3	Head of Quality Control Service	8.05.2023–10.05.2023
Planning for achieving quality objectives	5	Head of Quality Control Service, BSMK	11.05.2019 – 15.05.2019
Identifying suitable resources	5	Head of Service Quality control, BSMK	16.05.2023 – 20.05.2023
Conducting training according to a new quality standard	7	HR Director, Head of Quality Control	21.05.2023 – 27.06.2023
Management analysis of activities	4	Quality Director	28.05.2023 – 31.06.2023
Conducting internal audits	14	Head of Quality Control Service, BSMK, with the support of specialists from Audit-Optim-K LLC	1.06.2023 – 14.06.2023
Resolving inconsistencies	8	Head of Quality Control Service	15.06.2023 – 22.06.2023
Preparation for certification audit	10	Quality Director, Head of Quality Department, specialists of Audit-Optim-K LLC	23.06.2023 – 2.07.2023
ISM certificationin accordance with the requirements of ISO9001:2015	14	Representatives of the certification company of the Bureau Veritas group (when accompanying the audit from the specialists of Audit-Optim-K LLC	3.07.2023–16.07.2023

The activities to improve the quality management system are very labor-intensive and take a lot of time to implement all stages. The role of preparation and implementation is assigned to the top management and middle management. The CEO is the main person responsible for the implementation of the new improved quality management system. He gives assignments to the responsible persons to implement the QMS modernization and monitors its implementation, and responsibility for the process is assigned to the Deputy CEO - Director for Quality, who reports to the CEO on the progress of the procedures.

Table 8. Plan for improving internal regulatory documents in accordance with the requirements of ISO 9001 – 2015

Document Title	ISO Section	Type or form of document	Responsible for development	Ready to use
Order on the commencement of the process of improving the QMS and the distribution of responsibility for the procedure for improving the QMS	P. 5.2	Order	Representative of the management for QMS	
Amendments to the regulations on divisions, job descriptions, and the instruction "On the procedure for concluding and monitoring the execution of contracts"	P. 6.3	Changes to the regulations Schedule of those responsible for developing the QMS Changes in the instructions	Head of the Organizational Works Department Head of HR Head of Legal Department Management representative for QMS	April2023 April2023
Regulations "Planning in QMS" based on ISO 9001-2015	P. 8.1	Regulations	Representative of the management for QMS Head of the Planning and Economic Department	April 2023
Suggestions for Inclusions in quality objectives	P. 8.3	Suggestions for purposes	Representatives for divisions	April - May 2023
Regulation "Management of non-conforming products"	P. 8.4	Regulations	Head of Resource Planning and Product Quality Department Representative of the management for QMS	May 2023
Strategic goals in the field of quality	P. 8.5	Strategic goals	Representative QMS guidelines	May - June 2023
Regulation "QMS Guide" based on the new ISO 9001-2015 standard	P. 9.1	Regulations	Representative of the management for QMS	June 2023
Lists of records for each department	P. 9.2	Lists	Leaders divisions	June 2023
Order on completion of changes to QMS documentation in accordance with ISO 9001-2015	P. 9.3	Order	General manager	June - July 2023

This plan is approved by the general director of the enterprise.

Improving the qualifications of personnel for an enterprise that has embarked on the path of improving quality must be carried out as a continuous process, therefore, in the process of improving the QMS, the personnel of the organization must undergo additional training. A long-term personnel training program is created by the personnel training service with the cooperation of specialists from other companies, and is approved directly by the CEO of the base enterprise. The program must be provided with all the necessary resources. All employees are required to undergo training at the enterprise according to various training programs. Both the personnel of the enterprise and third-party specialists are involved in training. The management stimulates the improvement of the personnel qualifications by introducing additional bonuses to wages for the direct acquisition of professional skills in those areas of activity that are officially declared by the management as "unmet needs". A list of skills and abilities that the enterprise needs, means of proving their acquisition, as well as their percentage of the salary bonus is compiled annually and also communicated to the personnel of the organization. The specified bonus reaches up to

30%. Each member of the staff must have a personal plan for skill growth. Completion of training is taken into account in the current certification of managers and specialists.

To increase efficiency, various aids should be used.on quality management, memos for employees, engineering and technical personnel on the quality system. These guidelines disclose the goals, objectives of the enterprise in the area of quality, the structure of the QMS, the duties and rights of personnel in solving problems in the area of quality. Both employees of the enterprise and outside specialists are mobilized to form such manuals.

Certain needs and expectations of consumers must be accompanied by the QMS, implemented at all stages of its improvement. Attention should be paid to establishing the expectations of consumers, as well as other interested parties. Taking into account such expectations in the QMS allows us to ensure hope for a guarantee that it will not become obsolete in the near future. This makes it possible to take and maintain leading positions in our own market area. To assess such expectations, we should use or make forecasts of the development of consumer needs and services in the field of education.

The document "Mission, policy, goals and objectives in the field of quality" is the main document of the quality management system, since it sets out the main objectives of the enterprise in a concentrated form, gives a clear idea of its mission, its long-term goals and its positioning in the market.

Improving the quality management system is a set of works that affects various aspects of the enterprise's activities and its subsystems - the strategic management subsystem, the production subsystem, the logistics subsystem, personnel management, internal communications, document flow, etc. In this regard, improving the QMS is a rather difficult, long-term and labor-intensive task. And it consists of several stages. We will develop process maps for each department, division and department of the enterprise and present this in the form of Table 9.

Table 9. Process Map

Name of the process	Process Responsible	The purpose of the process
Financial management	Boss financial department	Planning, analysis and control of budget execution of financial needs for the implementation of production, investment and programs
Delivery process	Head of Sales Department	Delivery of finished products of the enterprise in the appropriate volume and within the appropriate timeframes
Accounting	Deputy Chief Accountant	Formation of complete and reliable reports on the activities and its financial position, to control compliance with the legislation of the Russian Federation in the implementation of business transactions and their appropriateness, the presence and movement of property and liabilities in accordance with approved standards.
Management review	Quality Director	Evaluation of the effectiveness of the QMS
Production of products	Technical Director	Achieving planned targets
Control and analysis of products	Head of Quality Control Department	Conducting timely product control in accordance with the inspection schedule and in accordance with approved methods
Delivery of products by transport	Head of Operations	Ensuring the fulfillment of the transportation plan, timely delivery and removal of wagons to loading and unloading areas.
Providing the enterprise with the necessary technical documentation for carrying out work	Chief Technologist	Ensuring compliance of technical documentation with design solutions, actual conditions, development of prospects for the development of work and related activities and proposals
Management of business activities of the enterprise	Chief Economist	Organization of planning and analysis of economic activities of the enterprise

The top management of the enterprise must ensure that quality objectives, including those necessary to meet product requirements, are established in the relevant departments and at the

relevant levels. Quality objectives must be measurable and consistent with the quality policy.

Goals are the tasks set for the organization to improve the quality of work, expressed numerically.

Since, when implementing a QMS, processes that describe the organization's work are also identified in the organization, it can be said that quality goals are set with reference to the corresponding processes.

Monitoring and changing processes, documenting processes This procedure is necessary in order to be able to assess the level development of the system and its impact on the economic performance of the enterprise. In order to draw conclusions about the functioning of the QMS, it is necessary to first measure the effectiveness of each process and document each process, measurements and documentation of processes. Table 10 presents the monitoring and measurement of QMS processes.

Table 10. System of indicators for measuring QMS processes

Process	Target	Result	Indicators for assessing the process and its result (performance criteria)	Who measures, frequency of assessment
Compliance with QMS requirements	Execution Production plan	Achievement 100% result	Compliance with QMS processes	Boss quality control services
Carrying out corrective actions actions	No marriage	Achievement 100% result	Number of corrections actions	Boss quality control services
Execution Applications for production of products within the established timeframes	Achieving planned targets	Achievement 100% result	The amount of applications processed	Boss quality control services
Fulfilment of the grade plan	Achievement product grades	Achievement 100% result	Number of product varieties	Boss quality control services

To improve the quality management system in an organization to meet the requirements of the ISO 9001-2015 standard, it is necessary to improve the internal audit procedure of the QMS. To maintain the quality management system (QMS) of an enterprise in working order and continuously improve the efficiency of its functioning, it is necessary to constantly improve and enhance all processes of the organization. When identifying priority areas for improvement, it is important to effectively use the advantages of the internal audit process. Internal audit is the main tool for assessing the effectiveness of the quality management system. The ISO 19011 standard defines audit as a systematic, independent and documented process of obtaining audit evidence and objectively evaluating it in order to establish the degree of fulfillment of the agreed audit criteria. The requirement to conduct internal audits of the quality management system is contained in clause 9.2 of the GOST R ISO 9001-2015 standard. The internal audit process refers to measurement processes.

Internal audits (inspections) of the QMS are usually conducted by the organization itself or on its behalf for internal purposes and can serve as the basis for a declaration of compliance of the internal company quality management system with the requirements of international quality standards. In this regard, the development of internal audit as an integral part of the internal control system is primarily due to the need for continuous operational control of activities for effective management. Internal audit of the management system allows solving the following tasks, namely:

analysis and elimination of the causes of identified discrepancies;

confirmation of compliance of the organization's activities and its results in the management system with established requirements;

assessment of the effectiveness of the functioning management system;

preventing the occurrence of quality problems;

establishing the degree of understanding by personnel of the goals, objectives and requirements described in the management system documents;

confirmation of the implementation of corrective and preventive actions and identification of ways to further improve the quality management system.

The organization and planning of internal audit consists of the distribution of responsibilities and authorities for the implementation of internal audit in the organization.

The organization's management ensures independent internal audit and analysis of the QMS. Owners, participants and interacting parties in the internal audit process and its stages are reflected in the responsibility matrix (Table 11).

Table 11. Matrix of distribution of responsibilities for stages of the procedure "Internal audit of management systems"

Responsible persons / Stages	Managing Director	Management representative	Technical Director	USM	OSMiS	Head of Audit Group	Head of the department being inspected
1 Development of a draft annual program of internal audits of the IMS	D	C	C	B	B	D	
2 Approval of the annual program	D	A	A	C	C	D	D
3 Preparation of internal audit plans				B	B	D	
4 Approval of internal audit plans		A	A	C	C		D
5 Preparation of information on the audited units and holding a meeting with the heads of audit groups				B	B	D	C
6 Preparation of the audit team				C	C	B	C
7 Conducting a preliminary meeting in the unit being inspected						B	C
8 Collection and verification of information				C		B	C
9 Conducting the closing meeting						B	C
10. Presentation of audit results				D		B	D
11 Development by the correction/CD unit				C	C	D	IN
12 Assessment of CD for sufficiency				B	B	D	D
13 Performing correction/CD						D	B
14 Checking the execution of the CD		D	D	C	C	B	C
15 Evaluation of the effectiveness of the CD		D	D	D	D	B	D
16 Analysis of the results of audits and implementation of the internal audit program of the IMS at the end of the year	D	D	D	B	B	D	D

Designations:

A responsibility for decision making;
B responsibility for implementation;
C responsibility for assistance;
D obtaining information.

Suggestions and recommendations on the organization and conduct of internal audit contribute to the improvement of the efficiency of the internal audit process and the internal control system as a whole. The improvement of the efficiency of internal audit largely depends on the correct organization of its work. During the internal audit, audit evidence is obtained. It is important that the evidence obtained is objective, as it can affect decision-making regarding the achievement of the goals and objectives facing the enterprise as a whole and its divisions. Also, during the internal audit, errors and discrepancies are identified that can affect customer satisfaction. The following discrepancies were identified with respect to the internal audit process:

the audit of the technical control department has not been conducted and is not included in the audit program;

the division is allocated in the organizational structure of the enterprise, and the current procedure for conducting internal audits provides for an audit of each division at least once a year;

the qualifications of internal auditors are not confirmed;

A certificate of training in the course “Internal Audit” was presented (the theoretical course was completed) without any positive training (testing) results.

Table 12. Measures to improve internal audit of the QMS in the organization

Disadvantages of conducting internal audits of the QMS	Measures to improve internal audits of the QMS
Insufficient competence of the audit team	Review the register of internal auditors, train new auditors, organize quarterly round tables, and replenish the library with specialized literature on quality assessment.
Lack of motivation of the audit team	Increasing the motivation of the enterprise audit team through additional bonuses based on work results
Changes in requirements for internal audit according to the standard GOST R ISO 9001 version 2015	Improving documentation
The audit of the technical control department has not been conducted and is not included in the audit program. The department is allocated in the organizational structure of the enterprise, and the current procedure for conducting internal audits provides for an audit of each department at least once a year.	Conduct an audit of the technical control department with inclusion in the internal audit program
There is no evidence to assess the extent to which planned activities have been implemented	Implement evidence to assess the extent of planned internal audit activities

Based on the results of the QMS analysis by senior management, it was noted that more than half of the selected improvement areas planned for 2023 were not implemented for subjective reasons. There is also no evidence to assess the extent to which the planned activities were completed. There is a psychological problem at the enterprise: the staff experiences "fear of audit". In addition, auditors included in the register of auditors of the enterprise quite often refuse to conduct an audit, citing their busy schedule. In this regard, an audit group is not formed, and the audit is carried out by one person, usually a QMS specialist. Improving the IA process should begin with an analysis of existing problems and identifying the causes of their occurrence using modern quality tools. Using the "brainstorming" method, many sub-reasons were identified for each main reason. As a result of the analysis, the most probable and significant reasons for the low quality of IA were identified: insufficient competence of the audit group, lack of motivation of the audit group, imperfection of the internal audit standard.

Based on the results of the IA process analysis, the following priority areas for process improvement were developed: improving the qualifications and competence of internal auditors, increasing the motivation of the enterprise audit group, and improving documentation. Taking into account the identified causes and priority areas, corrective measures were developed that allowed us to improve the IA process and bring it to a new important level.

As part of improving the competence of the audit group, a methodology for assessing the competence of internal auditors has been developed, which presents a scoring assessment of competence (Table 13).

Table 13. Criteria for assessing the competence of internal auditors

Item No.	Requirement	Evaluation criteria	Points
1	Education	Higher	3
		Secondary specialized	1
		Average and below	0
		More than 5 years	3

2	Experience	From 1 to 5 years	1
		Less than 1 year	0
3	Specialized training in the basics and principles of quality management	Eat	2
		No	0
4	Specialized training in internal audit of quality management systems	Eat	5
		No	0
5	Experience in conducting QMS audits	More than 5 audits	5
		From 1 to 5 audits	1
		No	0

Employees with higher education in the areas of “Quality Management” and “Standardization, Certification” receive 10 points.

The total score for an internal auditor is not less than 9. The total score for a chief auditor is not less than 12. An internal auditor must participate in at least one full audit per year, and the head of the audit team must participate in at least 3 audits per year.

This methodology allows for the most objective selection of auditors, which in turn will improve the quality of internal audit. It is proposed to develop a document called "Auditor's Passport" that will record information on the competence of internal auditors. In addition, the following recommendations are given to improve the competence of auditors: review the register of internal auditors, train new auditors, organize quarterly round tables, and replenish the library with specialized literature on quality assessment. To improve the motivation of internal auditors, a system of auditor remuneration has been introduced.

As part of improving the internal audit standard, the IA management procedure was improved, and document forms were brought to a unified form. As a result of the design, a block diagram of the internal audit of the organization's management systems was developed.

The following items have been added to the internal audit program: "Type and serial number of audit", "On-site audit time", "Reason", "Send audit report". The following items have been added to the internal audit report: "Reason", "Recommendations", "Audit criteria". The developed measures to improve the internal audit process allow for the rational use of enterprise resources to perform the QMS status check, have a positive impact on the efficiency of the organization's processes, which guarantees an increase in the quality of manufactured products.

Regulatory and organizational-legal documents governing the process:

GOST R ISO 19011;

Regulations on the quality management department;

job description of the head of the quality management department;

instructions for the activities of the head of the quality management system group;

instructions on the activities of internal auditors in the quality management system;

instructions for the activities of the management representative responsible for the quality management system;

Instructions on the activities of quality representatives of structural divisions.

Development of a document for coordinating work at the enterprise "Regulations on the definition and management of risks of the organization". The purpose of this document is to develop recommendations for the implementation of techniques and methods for identifying risks, to determine their application for the analysis, reduction and elimination of risks.

The section should contain the following items:

what is included in the procedure for assessing and managing risks that are associated with a direct impact on the quality of products or services;

the composition of the working group, as well as the group of responsible persons;

creation of a risk assessment system (identification, analysis, risk reduction) and critical control points;

responsibility for managing the risk analysis procedure;

defining powers in the working group;

definition of risk assessment methods, risk management methods;

evaluation of the results of the work of the working group – determination of the scope of application of the identification and analysis of risks associated with the quality of products or services.

Table 14. Risk assessment

Risk type	Cause	Risk Severity Assessment	Assessment of the probability of occurrence	Risk type	Adjustment of events
Technological risk	Decrease in production volumes	2	2	2	Compliance with design requirements documentation.
Commercial and supply risks	Refusal of suppliers to enter into contracts.	1	1	3	Diversification of production by expanding the number of ready-to-use technologies and types of products.
Risk of buyer refusal from the products received by him (return)	Non-compliance of products with quality requirements.	1	1	2	Horizontal integration, i.e. agreements with competitors on a kind of Division of spheres of influence.
Transport risk	Difficulty of obtaining hull and cargo insurance	1	1	3	Choosing a reliable insurance company.
Technical risks	Problems in the supply of technical materials, low qualification of workers	2	2	2	Improving the qualifications of personnel through advanced education, on-the-job training, efficiency applications for the purchase of technical components.
Risks in the field of human resource management	Wrong directions for choosing personnel policy.	1	2	1	Modernization of internal control systems, loyalty building program staff.
Risks in making management decisions	Incorrect construction long-term and short-term tasks for the development of the enterprise	2	1	2	Adjustment of strategic objectives based on identified development problems

Table 15. Risk Probability Assessment Scale

1	Low probability, the problem may occur approximately once a year
2	Average probability, the problem may occur approximately once a month
3	High probability, the problem may occur approximately once a week

4	As part of normal practice, the problem occurs constantly

Table 16. Risk Severity Rating Scale

1	To a certain extent, it increases the resource costs of executing the process, but does not affect its output.
2	Significantly increases the resource costs of executing a process or somehow worsens the process output characteristics
3	Significantly worsens the process output characteristics
4	Makes normal functioning of the process impossible

Table 17. Risk type

1	Unacceptable risk - the process must be changed to reduce the risk
2	Significant risk - the process should include actions to monitor the occurrence of this risk and respond to it
3	Minor risk - the risk requires minor adjustments to eliminate it

Upon completion of the work on risk identification, assessment and management, the final documents must be agreed upon:

- table "Identification and assessment of risks";
- risk assessment matrix;
- register of acceptable, justified, and unacceptable risks;
- creation of documents on critical and significant risks.

It is necessary to work according to the same methodology for calculating risks with the involvement of the same specialists. This is important for obtaining comparable final results.

Using risk analysis methodology, an audit can be conducted as follows:

the head of the department (quality representative) identifies potential non-conformities;

conducts a risk assessment (drafting a protocol);

carries out a plan and implementation of actions to reduce risks.

The objectives of the auditor when conducting a risk-based audit are to determine:

- whether potential discrepancies have been taken into account;
- Are the possible consequences indicated in the correct amount?
- the correctness of the assessment of the severity of the consequences;
- has the cause of the possible discrepancy been identified;
- the scope of risk reduction measures;
- implementation of planned activities;
- the effectiveness of these activities;
- Are the results taken into account in the processes and instructions?

Modernization (bringing the organization to compliance with the requirements) of the QMS according to ISO 9001-2015 is determined by the competence of the firm providing consulting and conducting all preparatory pre-certification work in the organization. Various details before certification work in the organization can significantly reduce capital expenditures on the implementation of the QMS. The following main one-time expenses of the organization can be indicated. The general characteristics of possible works and the approximate cost ratio of cost items are given in Table 18.

Table 18. One-time costs for improving the quality management system and ISO certification

Name of cost item	**Amount, thousand rubles**	**Share, %**
Training of internal auditors	135	13.22
Survey of the organization to obtain recommendations for the implementation of the new ISO 9001-2015 quality management system standard	42	4.11

Improvement of mandatory documents of the quality management system (for ISO 9001 – quality policy, quality manual, six mandatory documented procedures), change of additional (not mandatory according to the standard) documents of the QMS	110	10.77
Organization of an advisory body in the field of quality	22	2.15
Customer and client satisfaction surveys	18	1.76
Training employees on changes in the organization and new system documents	33	3.23
Internal audit of the quality management system	77	7.54
Elimination of comments identified at the stage of internal audit	88	8.61
Preparation for certification audit	56	5.48
Certification audit	440	43.09
Total	1021	100

Current costs here will also include imputed costs, such as lost profit (revenue, alternative income, etc.) that may arise from alternative investment of funds. The main items of current costs accompanying the processes of maintaining the QMS in working order, for the purpose of prolonging the validity of the certificate, are given in Table 19.

Table 19. Current expenses of the organization associated with the extension of the validity period of the certificate of conformity with the standard

Name of cost item	Amount, thousand rubles	Share, %
Internal audits of the quality management system (at least once a year)	250	25
Training of Certified Internal Auditors	100	10
Improving the qualifications of personnel (training) in quality management issues	50	5
Surveillance audits of the quality management system	600	60
Total	1000	100

In total, the implementation costs will amount to 1,021 thousand rubles, and then the current costs for the functioning of the QMS system will amount to 1,000 thousand rubles per year.

If the costs of the QMS are established by direct calculation, then the calculation of the "benefits" from improvement, certification of the quality management system is not so obvious, and also simple. The difficulty is aggravated by the implicit nature of most positive effects of improving the QMS. For an approximate calculation of the magnitude of such effects at the justification stage, it is necessary to use expert probabilistic assessments of the possible consequences of improving the system.

Table 20 shows the main areas of obtaining economic benefits from improving the QMS.

Table 20. Economic effects from improving the QMS

Type of economic effect	Source of the effect
Increase in profit proportional to increase in sales volumes	Expanding long-term relationships with consumers
Savings on fixed costs, their proportional share in the cost structure and growth in sales volumes	Increased demand from consumers
Reduction of total current expenditure	Optimization of business costs
Relative increase in revenues while maintaining the same level of current costs	Optimization of processes in the organization by searching for internal reserves

Thus, in general, economic feasibility is understood as a positive present value cash flow from the moment of investment in the QMS to a point in time in the future - the planning horizon of work in the area of quality. The project was created to carry out

improvement according to the ISO 9001-2015 standard. Objectives:

successful implementation of improvement according to ISO9001-2015;

increasing the efficiency of the QMS;

bringing the system into compliance with ISO 9001-2015 requirements to pass internal and external audits.

Internal improvement work includes:

work planning;

creation of the Working Group;

execution of works according to the work schedule;

control over the timing and quality of work performed.

The economic effect is very significant when introducing a new standard into the work of the enterprise QMS. Improving the QMS will improve all areas of the organization's activities and, in particular, the quality of products, which is so necessary for consumers.

As is known, the Pareto diagram can be used, in particular, to develop recommendations for optimizing production and business activities.To solve all sorts of problems related to the appearance of defects, equipment malfunctions, an increase in the time from the release of a batch of products to its sale, the presence of unsold products in the warehouse, and the receipt of complaints, the Pareto diagram is used.

The construction of the Pareto chart begins with the classification of the problems that arise by individual factors (for example, problems related to marriage; problems related to the operation of equipment or performers, etc.). Then follows the collection and analysis of statistical material for each factor in order to find out which of these factors are predominant in solving the problems. With regard to the construction and use of the Pareto chart, the following can be recommended, namely:

- it is advisable to use different classifications and to make many Pareto diagrams. The essence of the problem can be grasped by observing the phenomenon from different points of view, so it is important to try different ways of classifying the data until a few essential factors are identified, which is, in fact, the purpose of Pareto analysis;

-the group of factors "other" should not constitute a large percentage. A large percentage of this group indicates that the objects of observation are classified incorrectly and too many objects are in one group, which means that another classification principle should be used;

- if the data can be presented in monetary terms, it is best to show this on the vertical axes of the Pareto chart. If the existing problem cannot be assessed in monetary terms, the study itself may be ineffective, since costs are an important measurement criterion in management;

- if an undesirable factor can be eliminated with a simple solution, this should be done immediately, no matter how insignificant it may be. Since the Pareto diagram is considered an effective means of solving problems, only a few essential causes should be considered. However, eliminating a relatively unimportant cause in a simple way can serve as an example of an effective solution to the problem, and the experience, information and moral satisfaction gained can have a beneficial effect on the subsequent problem solving procedure;

- You should not miss the opportunity to draw a Pareto chart for reasons.

In a rectangular coordinate system, equal segments corresponding to the factors under consideration are plotted along the abscissa axis, and the magnitude of their contribution to the problem being solved is plotted along the ordinate axis. The order of the factors is such that the influence of each subsequent factor located along the abscissa axis decreases compared to the previous factor (or group of factors). The result is a diagram whose columns correspond to individual factors that are the causes of the problem, and the height of the columns decreases from left to right. Then, a cumulative curve is plotted based on this diagram.

Building a Pareto chart in Excel consists of the following steps.

Let's assume that we have activity data.

The data is not ordered, so first of all we will sort the data by decreasing profit of the number of defects. To do this, select the table and select Data -> Sort and filter -> Sort in the tab bar. Additionally, we added several columns to the table, namely:

- cumulative profit percentage, % - each product is added to the previous one and the total share in profit is shown;
- efficiency coefficient - in this case 80% (according to the Pareto rule);
- highlighting criterion - the main defects will be highlighted in the final diagram, we specify a value that is obviously greater than 1.

Now we will transform the graph into a more convenient form. Select the series "Increasing percentage of defects, %" and move it to the secondary axis (right-click on the series, select Format data series -> Series parameters -> By secondary axis)

We will also change the chart type for this series to a regular line chart (right-click on the series, select change chart type for series)

Next, we perform similar actions for the “Coefficient” series, which we transfer to the auxiliary axis and make a horizontal line.

Let's add a highlight to the chart that shows which specific product groups bring in the main profit. Select the "Highlight" row and move it to the secondary axis. Set the lateral gap to 0 - right-click on the row, select Format Data Series -> Row Parameters -> Lateral Gap

We customize the diagram at our discretion and get the final form of the Pareto chart in Excel. But in this program, the author identified errors, inaccuracies and inconsistencies, which distorted the final results and did not allow them to be used, although the Pareto chart allowed researchers to distribute their efforts to resolve emerging problems and establish the main factors with which to begin the study in order to achieve effective results. Let's clarify the stages of solving the problem of constructing a Pareto chart in Excel, namely:

Stage 1. First you need to decide:

1. what problems need to be investigated (e.g. defective products, lost money, accidents);
2. what data needs to be collected and how to classify them (for example, by type of defect, by location of their occurrence, by process, by machine, by worker, by technological reasons, by equipment, by measurement methods and measuring instruments used; infrequently encountered features are combined under the general heading "other");
3. determine the method and period of data collection.

Stage 2: Develop a data recording checklist listing the types of information to be collected.

Stage 3. Filling out the data registration sheet and calculating the totals.

Stage 4. Develop a table for data checks with columns for totals for each checked feature separately, the accumulated sum of the number of defects, percentages of the total, and accumulated percentages (Table 21).

Stage 5. Arranging the data obtained for each verified feature in order of importance and filling out the table (Table 21).

Table 21. Results of data registration by defect types for constructing the Pareto diagram.

Types of defects	Number of defects	Cumulative sum of the number of defects	Percentage of defects for each feature to the total amount	Cumulative percentage,%
Deformation	104	104	52	52
Scratches	41	146	21	73
Shells	20	166	10	83
Cracks	10	176	5	88
Stains	6	182	3	91
Breakup	4	186	2	93
Others	14	200	7	100
Total	200	—		

The "other" group should be placed in the last line regardless of its numerical values, since it consists of a set of features, the numerical result for each of which is less than the smallest value obtained for the feature allocated in a separate line.

Stage 6. Application of horizontal and vertical axes.

The vertical axis contains percentages, and the horizontal axis contains intervals according to the number of controlled features.

The horizontal axis is divided into intervals in accordance with the number of controlled features.

Stage 7. Plotting a bar chart.

Stage 8. Drawing a cumulative curve (Pareto curve) on a diagram

Stage 9. Applying all designations and inscriptions related to the diagram (name, marking of numerical values on the axes, name of the controlled product, name of the diagram compiler) and data (collection period) to the diagram.

information, the object of the study and the place where it is conducted, the total number of objects of control).

After identifying the problem by constructing a Pareto chart based on the research resultsIt is important to determine the reasons for their occurrence. This is necessary for its solution. When using the Pareto chart to identify the results of activities and causes, the most common method is ABC analysis.

The essence of ABC analysis in this context is to define three groups that have three levels of importance for quality management:

1.Group A - the most important, essential problems, reasons, defects. Relative percentage of group A in the total number of defects (reasons) usually ranges from 60 to 80%. Accordingly, the elimination of group A causes has high priority, and the related activities have the highest efficiency;

2. Group B - reasons that together account for no more than 20%;

3. Group C - the most numerous, but at the same time the least significant reasons and problems.

ABC analysis allows you to reasonably determine the priorities of work on project quality management. Adjustment to the software for constructing the Pareto chart

1. Step Cumulative percentage cannot be more than 100.

2. The step for the right ordinate axis is selected (set) equal to only 10%.

3. The step for the left ordinate axis is determined by the step specified for the right ordinate axis, namely, equal to 10%. And their number for the left ordinate axis is set to 10 equal values. But these values, that is, the step, is accepted scaled, namely, 1:1, 1:2, 1:5, 1:10 or 1:1, 2:1, 5:1, 10:1 and at the same time the number 10, multiplied by the selected value for the step of the left ordinate axis is formed for the defect, the value of which is the greatest. If, for example, 77, then the nearest number is 100. Since the step will be equal to 10. And this meets the scaling requirements, namely, 1:1. And this procedure is strictly regulated, so, for example, if this number is 20, then in this case the step will be equal to 2. If the value is 40, then the step will be equal to 5. Although it is allowed to use a scale of 1:4 or 4:1, it is better not to use them. Scaling is an important point in the formation of the algorithm and design of the software product for constructing the Pareto diagram. The abscissa axis is formed by the number of detected defects, but preferably no more than 10, and is formatted with the width of an A4 sheet. At the same time, authors can choose a portrait or landscape format. But in any case, the abscissa axis is formed by the width of the sheet. Another condition that must be met when constructing the Pareto diagram is that the value of other defects, taken out into their total number, must be less than or equal to the smaller one. Formation of the ordinate axis encounters difficulties if the step needs to be set to be less than 1.0, i.e. 0.2 or 0.5 – in this case the software product does not form the axis using the specified step, it may be necessary to use the step designation as 2 or 5, but we were unable to check this version.

The program of improved construction of Pareto diagram in statistical research for the purpose of quality control of products is intended forsolutions to all kinds of problems related to the appearance of defective products, equipment malfunctions, an increase in the time from the release of a batch of products to its sale, the presence of unsold products in the warehouse, the receipt of complaints, etc.

The construction of the Pareto diagram begins with the classification of the problems that arise by individual factors (for example, problems related to defects; problems related to the operation of equipment or performers, etc.). Then follows the collection and analysis of statistical material in order to identify the prevailing factors (i.e. factors with the most numerous manifestations). With regard to the construction and application of the Pareto diagram, the following can be recommended, namely:

- it is advisable to use different classifications and create a Pareto diagram for each of them;
- the specific weight of the “other” factor group should not exceed 10% of the total number of manifestations;
- it is possible to use the Pareto diagram in cases where the frequencies of occurrence of factors are replaced by monetary amounts (for example, the amounts of lost profits);
- if an undesirable factor can be eliminated with a simple solution, this should be done immediately, no matter how insignificant it may be;
- the opportunity to draw up a Pareto chart should not be missed due to the manifestation of negative factors.

In a rectangular coordinate system, equal segments corresponding to the factors under consideration are plotted along the abscissa axis, and the number of their manifestations along the ordinate axis. In this case, the order of the factors is such that the influence of each subsequent factor occupying a place on the abscissa axis does not increase compared to the previous factor. The result is a diagram whose columns correspond to the factors under consideration, with the heights of the columns decreasing in a non-strict sense. Then, a cumulative curve is plotted based on this diagram.

The Pareto diagram allows identifying the most significant factors, which makes it possible to rationally distribute efforts to resolve problems caused by the negative influence of factors. These efforts should be aimed, first of all, at limiting the manifestation of the prevailing factors (in the diagram below, they correspond to the green columns).

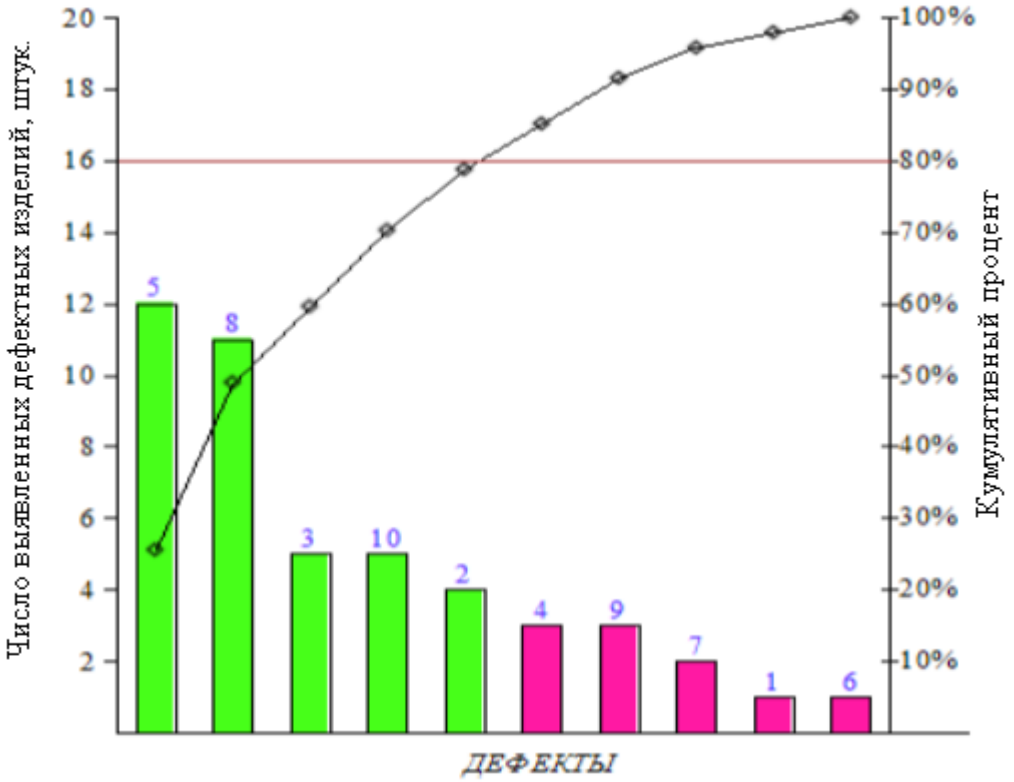

Figure -15 Example of calculation for 10 defects.

About the algorithm for constructing the Pareto chart.

Let the study of a certain batch of products show the presence in it$n$defects, where the -th defect was detected times, It is required to construct a Pareto chart based on this data. The algorithm for solving the problem is described below.$p_j j = 1, 2, \dots, n$.

I. We calculate the quantities sequentially

$$\tau_j = \sum_{i=1}^{n} sign\left(1 + sign\left(p_i - p_j\right)\right), j = 1, 2, \dots, n;$$

$$\eta_j = 1 + \tau_j - \sum_{i=1}^{n}\left(1 - \left(sign\left(\tau_i - \tau_j\right)\right)^2\right) sign(1 + \ sign(i - j)), j = 1, 2, \dots, n;$$

$$x_j = \sum_{i=1}^{n} p_i(1 - (sign(\eta_i - j))^2), j = 1, 2, \dots, n.$$

Each of the defect detection numbers occurs in the sequences and the same number of times; in this case, the Value is the number of the value in the sequence (in this case, the implication is $x_1, x_2, \dots, x_n \ \ p_1, p_2, \dots, p_n \ \ x_1 \geq x_2 \geq \ \dots \ \geq x_n . \eta_j p_j \ \ x_1, x_2, \dots, x_n, \ \ j = 1, 2, \dots, n \ \ 1 \leq i < j \leq n, \ p_i = p_j \ \Rightarrow \ \eta_i < \eta_j$).

II. We construct a rectangular Cartesian coordinate system on a plane with one horizontal and two vertical axes. In this case, the vertical axes are depicted as equal vectors perpendicular to the "vector" of the horizontal axis (hereinafter referred to as HA) and plotted from some two points on HA that are sufficiently distant from each other. All columns of the Pareto diagram will be located between the vertical axes and adjoin the HA from above. We will describe the position of these columns on HA. We will proceed from the fact that: a) the width of each column and the width of the gap between any two adjacent columns are equal to the same number; b) the width of each of the two gaps - between the left vertical axis (hereinafter referred to as LVA) and the first column, as well as between the -th column and the right vertical axis (RVA) - is equal to. We will take the intersection points of the LVA and RVA with HA as zero and one on HA, respectively. Then the sum of the above widths is equal to one: It is easy to see that the base of the -th column of the diagram is the segment

GO, i.e. the segment $,n\varepsilon;\frac{\varepsilon}{2}n\varepsilon+(n-1)\varepsilon+2\cdot\frac{\varepsilon}{2}2n\varepsilon=1\ \Rightarrow\ \varepsilon=\frac{1}{2n}.\left[\frac{\varepsilon}{2}+2(j-1)\varepsilon,\ \ \frac{3\varepsilon}{2}+2(j-1)\varepsilon\right]=\left[\frac{1}{4n}+\frac{j-1}{n},\frac{3}{4n}+\frac{j-1}{n}\right],\left[\frac{4j-3}{4n},\frac{4j-1}{4n}\right]\ \ j=1,2,\dots,n.$

III. We divide the segment of the air defense from its beginning (i.e. from the common point of the civil defense and the air defense) to some point at the top of the air defense (say, one or two centimeters away from the end of the air defense) into 10 equal parts. Near these divisions to the right of the air defense we successively place the inscriptions 10% (at the bottom, not counting the beginning of the air defense, division), 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% (at the top division). The procedure for selecting a scale on the LVO and applying divisions to it is determined by the value x_1(see item I). For this purpose, we calculate the following values:

$$l=10^{-[-lgx_1]-2},t=-lgx_1$$
$$=\begin{cases}10l & \text{при}\quad t<lg2\\ 5l & \text{при}\quad lg2\le t<lg5\\ 2l & \text{при}\quad t\ge lg5\end{cases}$$

(here, as usual, there is an integer part and a fractional part of the number$[x]\{x\}-x$).There are four possible cases here.

1) $x_1\ge 6$. We apply ten divisions on the LVO opposite the divisions 10%, 20%, …, 100% on air defense. Next to these divisions on LVO and to the left of it we indicate the numbers $q,2q,\dots,10q$ respectively.

2) We apply five divisions on the LVO opposite the divisions $3\le x_1\le 5$. 20%, 40%, 60%, 80%, 100% on the air defense. Next to these divisions (on the LVO; to the left of it) we indicate the numbers 1,2,3,4,5 respectively.

3) We apply two divisions on the LVO opposite the divisions $x_1=2$. 50%, 100% on air defense. Next to these divisions (on LVO; to the left of it) we indicate the numbers 1,2 respectively.

4) We put one division on the LVO opposite the division $x_1=1$. 100% on air defense. Next to this division (on the LVO to the left of it) we indicate the number 1.

Note that numbers near the LVO will always be positive integers.

IV. We construct the columns of the Pareto diagram. Taking into account the conclusion obtained in section II, it remains only to determine their heights. Each of the defects corresponds to its own column, namely, the -th defect corresponds to the column with the number (see section I; we emphasize that the columns of the Pareto diagram are always arranged in order of non-increasing heights). For each, we set Let us agree to call the length of the segment [10%, 20%] of the PVO the unit of height. It follows from the content of section III that, regardless of the value, the height of the -th column of the Pareto diagram will be such units. The name of the defect with the number should be signed under this column, $n\eta_j,\ j=1,2,\dots,n\quad 1\le j\le n\quad \theta_{\eta_j}=j.x_1\,x_k/q\,\theta_k\quad k=1,2,\dots,n.$

V. Having calculated the accumulated amounts of defects and the values proportional to them, we plot points with coordinates on the diagram (they lie on the vertical axes of symmetry of the diagram columns. The ordinates of these points are expressed in units of height). By connecting sequentially, we obtain a broken line (in this case, it is desirable to depict the points as small-radius circles). In addition, we connect the vertical axes with a horizontal line segment at the 80% mark on the PVO. The broken line and the segment should be depicted in different colors, for example, brown and yellow, respectively. Let (turns out to be a non-negative integer less than) By introducing another designation, we assign a number that always satisfies the inequalities Let us color the first columns of the Pareto diagram in the third (for example, green) color, and the remaining columns in the fourth (say, red) color. The share of defects represented by green columns accounts for 80% (or about 80%) of the total number of detections.

$$S_k=\sum_{j=1}^{k}x_j\,y_k=\frac{10S_k}{S_n},A_k\left(\frac{2k-1}{2n},y_k\right),$$
$$k=1,2,\dots,n$$
$$A_kA_km=\sum_{k=1}^{n}sign(1+sign(8-y_k))\,mn.$$
$$y_0=0,$$
$$r=\frac{2m+1+sign(16-(2S_n)^{-1}-y_m-y_{m+1})}{2},$$
$$1\le r\le n.r$$

VI. In conclusion, we note the advantages of the algorithm proposed in this paper in comparison with some other algorithms for constructing the Pareto diagram known to its authors.

a) This algorithm uses formulas containing function values, which greatly simplifies the calculation procedure. $signx,$

b) In all possible cases, the PVO contains only divisions of 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, i.e. there are no divisions that go beyond the range of 0%100% (and the presence of such excess divisions is completely meaningless for the Pareto diagram).÷

d) The choice of scale on the LVO meets the following highly desirable requirements: c1) the largest of the columns of the Pareto diagram does not exceed the 100% mark on the PVO; c2) opposite this mark on the LVO there is a mark corresponding to the smallest possible (under condition c1)) number of defects, a multiple of two and (or) five.

d) In all cases, only divisions corresponding to whole numbers are applied to the LVO.

Thus, the software guarantees the researcher the receipt of objective results for making informed

decisions. The proof of the legitimacy of using the program is confirmed by the conducted studies of the analysis of the results of the activities of Techmash Plant LLC to identify the causes of defects in manufactured products for 2022, and the development of measures to significantly reduce them.

In the process of manufacturing any products, it is impossible to obtain all products of identical quality, i.e. the parameters of different units of products fluctuate within certain limits. This fluctuation is caused by a complex of random and systematic causes that act in the production process and determine the errors of a given technological process. If the fluctuation of parameters is within acceptable limits (within tolerance), then the product is suitable, if it goes beyond these limits, it is defective.

The quality of manufactured products at the enterprise OOO Zavod Tekhmash is determined by the quality of the initial products, the degree of equipment adjustment, and compliance with technological modes. In order to promptly identify defects and the reasons that caused them, it is necessary to carry out systematic control of product parameters, receive and process data on the controlled parameters. Using methods for analyzing the causes of defects and defects in manufactured products and developing measures to prevent them, it is possible to find a solution to problems that arise in the production process, for example, the cause of defects.

Defect – each individual non-conformity of a product to the requirements established by regulatory documentation.

A defect can exist at every stage of the product life cycle.

Providing free approaches to controlled parts at the design stage eliminates the need to modify the design of products during operation to carry out control.

Based on the analysis of design stresses, the results of static and dynamic tests, as well as statistics of failures during operation of similarly designed equipment models, the designer must determine which highly loaded parts and units are subject to NDT during operation, where the places of possible occurrence of fatigue cracks and control zones are.

The designer must specify the methods and means of NDT, including devices for built-in flaw detection testing of objects, the ability to test which must be provided in the planned volume. If it is impossible to use known methods and means of testing, it is necessary to develop and recommend new ones.

The designer must develop technical documentation on flaw detection testing, including a list of objects to be tested and their placement schemes on the product, recommended methods, means and technology of testing, rejection criteria, sequence of testing, procedure for introducing testing under operating conditions of the product and subsequent expansion of its scope. In addition, the duration and necessary labor costs for preparation and performance of testing operations must be determined.

Work on ensuring the manufacturability of products and creating technical documentation on flaw detection testing is carried out by the designer together with specialists in flaw detection, production and operation of machines - objects of testing. Due to errors made at the design stage by the designer, defects arise in products.

The largest number of defects detected by NDT methods at Techmash LLC occur at the manufacturing stage of products.

Let's consider metallurgical defects that form during the smelting of ingots or casting of parts. The most common metallurgical defects are: shrinkage and gas cavities, cracks and inclusions.

Shrinkage cavities are a cavity formed as a result of the reduction in the volume of liquid metal during its solidification. The reason for the formation of such a defect is the reduction in the volume of metal during solidification.

Blowholes are round cavities with a diameter of 1...3 mm or more with a smooth, shiny surface. The main causes of their occurrence may be: low gas permeability of the mold and rods; poor processing of refrigerators, etc.

Cracks are discontinuities in the form of metal ruptures. The formation of cracks in a continuous ingot is associated with stresses that arise during its formation and is caused by reduced strength and plasticity of the metal in various temperature ranges.

Inclusions are of two types and origins: inclusions of non-metallic particles that have entered the metal from the outside (slag, refractory, sand, graphite) and metallic inclusions (ferroalloys, sunken pieces of rods or marking arches, etc.)

Formation of defects in products of Techmash Plant LLC may occur due to a number of reasons related to process management. The main factor influencing the omission of defects is the qualification, certification and training of personnel, as well as the conscientious performance of the flaw detector's work.

The most common type of defects are cracks on parts processed by volume stamping methods. A crack is a pure (transparent) discontinuity that passes along or through grain boundaries. Usually, the cause of cracks is local overstress of the metal during stamping or other shaping operations, or a consequence of heat treatment. Cracks of this group are usually divided into longitudinal, shear, internal and transverse.

Let's look at the example of the rotary harrow hoe BMR, which has the greatest number of defects.

The unit is designed for continuous and inter-row processing of any crops, grain, soybeans, row crops, tobacco, vegetables, etc. Moreover, this tool is especially effective in regions where there is a lack of

moisture for moisture conservation. It is used to combat weeds, incorporate crop residues into the soil. The most common defect of this harrow is disk jamming. Jamming of the rotating disk occurs due to failure of the bearing unit. This is due to the fact that low-quality bearings are used to manufacture the disk working element. The way out of this situation can be the purchase of higher-quality bearings.

The second most common defect is deformation and fracture of disks and load-bearing parts of metal structures. This is due to poor quality metal processing during the manufacturing process of the part.

A defect on the surface of metal and metal products, accompanying their heat treatment, is the formation of a decarburized layer due to the burnout of part of the carbon during heating of the metal for subsequent hardening. Decarburization of the metal surface can take place both at the stages of rolling, preparation of metal for upsetting, and during heat treatment for the corresponding strength class of finished parts. Decarburization and scale formation significantly reduce the mechanical properties in the surface layers of the metal, the surface becomes susceptible to the formation of scores, burrs, scratches during rolling, calibration, upsetting, and thread stripping is possible during mechanical testing. The use of protective atmospheres during heating would significantly reduce the likelihood of the formation of a decarburized layer.

During heat treatment of rod parts, especially with a rod length of more than ten diameters, warping of the product and distortion of the geometric dimensions of the thread are possible. It is possible to eliminate such a defect only by using isothermal hardening in more viscous hardening media.

Hardening cracks in deformed metal may appear during hardening as a result of high stresses of structural transformations and temperature stresses. Hardening cracks usually have an uneven wandering trajectory on the surface of the fastener. The main reasons for the appearance of temperature stresses are: rapid heating for hardening, rapid cooling in the martensitic transformation area, complex configuration of the product with sharp transitions, a significant time gap between hardening and tempering operations.

Defect control at Techmash Plant LLC. It is carried out by a special commission and employees authorized by the head of the Quality Control Department or higher-level managers.

Incoming (preliminary) inspection is carried out before the start of the technological process of processing or assembling items. Its purpose is to identify and eliminate the causes of defects (poor quality of items and tools, etc.) and thereby prevent them. This includes inspection of materials, blanks or parts before their processing or assembly, inspection of devices and measuring instruments, as well as adjustment inspection. During adjustment inspection, the first copies of parts processed after equipment adjustment are checked. Based on the results of this inspection, a decision is made on continuing work or on the need for equipment adjustment.

During intermediate (interoperational) control, the quality of individual operations (operational control) or their group (group control) is checked. Its purpose is to identify defects during the technological process and thereby prevent labor costs for processing defective parts in subsequent operations, especially labor-intensive and expensive ones.

During acceptance (final) inspection, finished blanks, parts, and assembly units of the machine are checked after the last (final) operation in a given workshop before being handed over to the warehouse, or before being transferred to the next workshop, or before being sent to the consumer. Its purpose is to prevent the transfer of defective products to the consumer.

Active control means control in which quality is checked during the technological process, and the results of the control are used for current regulation of the process. This includes control of quality indicators of items and regulation of the technological process using mechanical and automatic devices built into the main equipment (indicators, pyrometers, measuring heads, etc.) and allowing control of the necessary parameters of parts or modes during processing. Active control should also include statistical regulation of technological processes, the principles of organization of which are considered in the next paragraph. Passive control includes all types of control in which quality is revealed only after the end of the technological process, and operational intervention in the process is carried out after detection of unsuitability of the product. This should also include checking parts using technical devices that determine the actual level of their quality after manufacture (control and sorting machines for balls and rollers for bearings, pistons, piston rings, pins and other cylindrical parts).

The number of defects detected in the forging for 2024 is shown in Table 6, and in Figure 28, the constructed Pareto diagram for the defects detected for 2024, the expected number of defects in 2025 is shown in Table 7, and the constructed Pareto diagram in Figure 16.

Table 22. Characteristics of product defects at Techmash Plant LLC for 2024

Name of defects identified in sold machines	Number of defects detected in sold machines	Cumulative share of detected defects	Total number of defects detected (cumulative percentage)
Bearing defect	17	38%	38%
Jamming of rotation disks	9	20%	58%
Violation of the technology of hardening the part	5	11%	69%
Frame deformation	4	9%	78%
Disc Crack	3	6%	84%
Others	7	16%	100%
Total	45	100%	

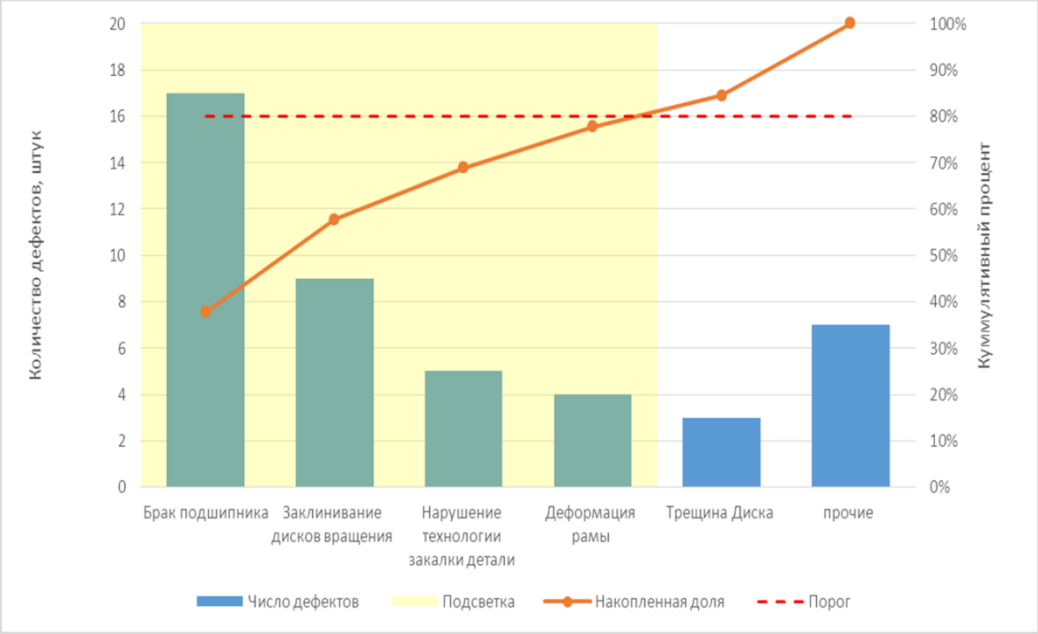

Figure 17. Pareto chart and cumulative curve characterizing product defects identified in 2024Techmash Plant LLC

Table 23. Characteristics of product defects at Techmash Plant LLC for 2025 (expected)

Name of defects identified in sold machines	Number of defects detected in sold machines	Cumulative share of detected defects	Total number of defects detected
Jamming of rotation disks	4	38%	38%
Violation of the technology of hardening the part	3	20%	58%
Frame deformation	2	11%	69%
Wheel axle deformation	2	6%	84%
Disc Crack	1		
Others	1	16%	100%

Total	13	100%	

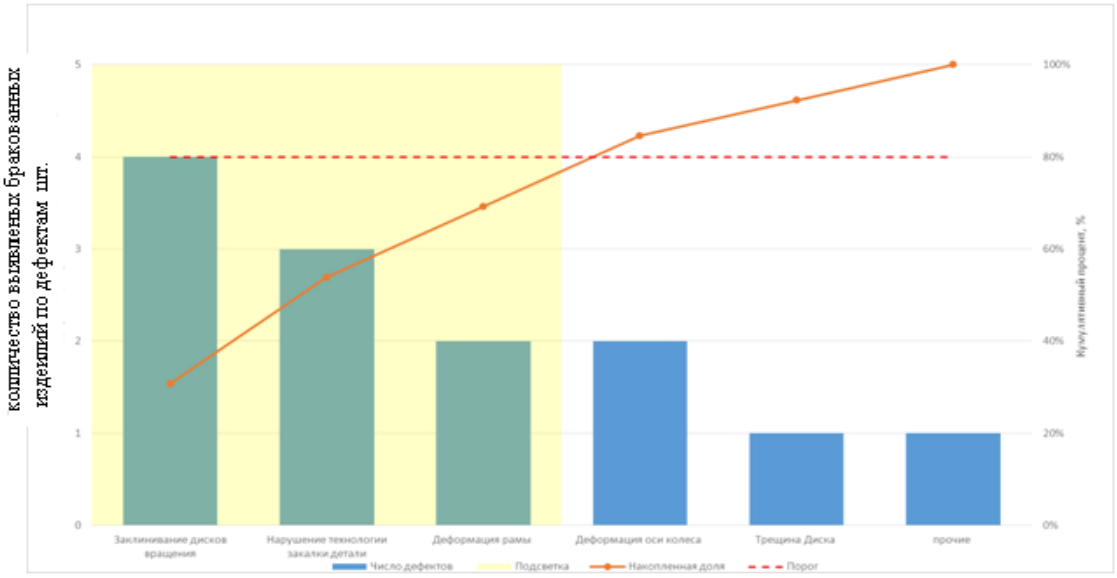

Figure 18 -Pareto chart and cumulative curve characterizing product defects identified in 2025 (expected)Techmash Plant LLC.

Measures to reduce the output of defective products at Techmash Plant LLC. The main tasks of the control service of Techmash Plant LLC are: to systematically, promptly and efficiently control the quality of incoming materials and products, technological (assembly) works, the quality of manufactured products, the technical condition of products during operation using the necessary methods and means of control in accordance with the requirements of the current documentation; to prevent the transfer of defective products for subsequent technological operations or their delivery to the customer; to promote the improvement of the quality of design, technological, assembly, repair and other works; to accept the completed operations and works with the execution of the necessary technical documentation and to participate in the delivery of materials and products to the customer; to develop organizational and technical measures aimed at preventing defects and improving the quality of development and manufacture, as well as improving the technical level of operation of products.

Control and diagnostic operations should be considered as the most important process stage that ensures quality with all the ensuing conclusions. The efficiency of the final result - long-term operability of objects at minimum costs - largely depends on the correct choice of ND. As an example, we can cite the method of testing large-diameter pipes using hydraulic presses, which is still in use, for which it is necessary to build special workshops and multi-ton testing equipment. At the same time, an automated ultrasonic flaw detector allows you to identify defects with greater reliability than hydraulic testing, while the costs of control are reduced hundreds of times. Test algorithms should be formed by diagnostic technology in order to determine what and how to use. It is the technology that should minimize diagnostic parameters, methods and means that ensure the reliability of determining an abnormal event.

It can be argued that there is no single error-free testing method. Unforeseen operating conditions may occur, so diagnostic technologies must be "redundant" in terms of the use of a set of different NDT methods and techniques that would complement each other to ensure maximum product quality assurance.

The technology should provide a range of different designs of control and diagnostic devices - from manual to automated execution with a rational combination of their use in the processes of production, testing and operation of objects. It should have a library of algorithms and diagnostic programs, implemented in relation to specific products, operations and tasks of detecting defects.

The most important moment - the decision on the non-compliance of the product with the requirements and the termination of its operation or functioning - must be specially noted and scientifically substantiated in the technology. The

foundation of this decision is the previously collected statistical material.

Diagnostic technologies must be pre-tested, they cannot contain unreasonable requirements in the form of "no types of defects are allowed", they must work only in advance, reliably recognize a pre-emergency situation, and in no way allow emergency operation of products. The main thing is not the calculation of the sizes of defects (defectometry), but the determination of the residual life of the object of control, the degree of risk of its operation.

Organization and implementation of technical quality control are one of the components of the quality management system at the stages of production and sale of these products. The process of interaction of production factors at the enterprise, aimed at converting the initial raw materials (materials) into finished products suitable for consumption or further processing, forms the production process or production.

The quality of manufactured products at the enterprise OOO Zavod Tekhmash is determined by the quality of the initial products, the degree of equipment adjustment, and compliance with technological modes. In order to promptly identify defects and the reasons that caused them, it is necessary to carry out systematic control of product parameters, receive and process data on the controlled parameters. Using methods for analyzing the causes of defects and defects in manufactured products and developing measures to prevent them, it is possible to find a solution to problems that arise in the production process, for example, the cause of defects.

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