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ON THE IMPORTANCE OF OPTIMIZING THE NORMATIVE AND TECHNICAL DOCUMENTATION OF THE QUALITY MANAGEMENT SYSTEM TO ENSURE THE PRODUCTION OF DEMANDED AND COMPETITIVE PRODUCTS

Abstract: in the article the authors justifiably paid attention to solving the problem of combining state and market mechanisms for managing competitiveness because it becomes a strategic resource for the economy of these regions. Today, and even more so tomorrow, in the world economy, the place of price competitiveness will be taken by the competitiveness of quality levels, which will widely increase its significance in connection with Russia's accession to the WTO and the need to use ISO 9000 series, in this regard, an increase in the quality factor of the results of the activities of the domestic light industry in The strategy of competitive struggle in world markets is for those enterprises that, due to external factors (increased competition due to globalization, the global financial crisis) and internal (ineffective management), have lost their competitive positions in the domestic and foreign markets.

Key words: quality, import substitution, demand, competitiveness, market, profit, demand, buyer, manufacturer, financial stability, sustainable TPP, attractiveness, assortment, assortment policy, demand, sales. paradigm, economic policy, economic analysis, team, success.

Language: English

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Introduction

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To analyze the quality of services of LLC Plant "Techmash", a certain information base is required. The sources of information are the data obtained by the marketing department in the course of research of the external environment of the enterprise.

Marketing research of the sales markets for the software product, the services provided in the field of programming and maintenance, made it possible to identify their features, namely, the sales market for the software product developed by the authors. The buyers of the software product are exclusively economic enterprises of the Rostov region and nearby settlements that need technical support. As a result,

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both the technical support itself and its maintenance can be considered an urgent need for the specified buyer.

The product market is characteristic:

a high level of elasticity of demand - potential buyers, not understanding the specifics of certain configurations, are guided by price.*

growing competition, in the surrounding areas there are already enterprises with similar activities.*

* market instability, which consists in the lack of a sufficient volume of technical support.

Achievement of high quality services of Tekhmash Plant LLC and its competitors is a rather elusive goal. However, with targeted approaches, such a goal is achievable.

When building a quality management system, the management of Tekhmash Plant LLC relied on the principles formulated in the ISO 9000 standard:

*customer orientation. The organization depends on its customers, therefore, must understand their current and future needs, fulfill their requirements and strive to exceed their expectations;

leadership leadership. Leaders ensure the unity of purpose and direction of the enterprise. They should create and maintain an internal environment in which workers can be fully involved in solving the problems of the enterprise;*

involvement of employees. Employees of all levels form the backbone of the enterprise, and their

full involvement in the work of the company enables him to take advantage of his abilities;*

*process approach. The desired result is achieved more efficiently when activities and associated resources are managed as a process;

*systematic approach to management. Identification, understanding and management of interrelated processes as a system contribute to the effectiveness and efficiency of the enterprise in achieving its goals;

* continuous improvement. Continuous improvement of the enterprise as a whole should be seen as its permanent goal;

*decision making based on facts. Effective decisions are based on the analysis of data and information;

*mutually beneficial supplier relationships. An enterprise and its suppliers are interdependent and mutually beneficial relationships enhance the ability of both parties to create value.

Research on the quality of manufactured products at OOO Plant "Techmash" in Shakhty provoked a desire to form goals and objectives within the framework of the QMS for them in order to significantly improve the quality of products. The plant produces continuous transport machines (conveyor and conveyor equipment), agricultural soil processing equipment, equipment for transportation, storage and processing of grain products (elevators, HPP, sugar factories), shaped pipes. (Table 1).

Table 1 - Characteristics of the assortment of machines manufactured by LLC Plant "Techmash", and a list of defects for 2020, including those manufactured with defects and returned by consumers at the end of 2020.

Types of products	Planned number of products	Actual number of products released	Number of defective products	Product defect	Product price
Harrow rotary hoe BMR-6 n	37	35	9	Bearing inappropriate to nomenclature	480,000
Harrow rotary hoe BMR - 9 ns	25	25	5	Jammed rotation discs	690,000
Harrow rotary hoe BMR-20	22	20	2	The use of a non-original cheaper copy of the bearing assembly	1,080,000
Extended disc harrow BDU 4x2	11	10	2	Violation of the part hardening technology	785,000
Extended disc harrow BDU 5x2	7	7	1	Crack disc	1,433,000
Extended disc harrow BDU 6x2	4	4	1	Violation of the part hardening technology	1,642,000
Seeder Vega 6	10	10	3	The frame is not correctly designed. Wheel axle deformation	1,550,000
Total	126	118	29/8		

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

The quality of the manufactured products at the enterprise LLC "Plant" Techmash "is determined by the quality of the initial products, the degree of equipment tuning, compliance with the technological regimes. In order to timely identify defects and the causes that caused it, it is necessary to carry out systematic control of product parameters, to receive and process data on controlled parameters. Using the methods of analyzing the causes of defects and defects in manufactured products and developing measures to prevent them, it is possible to find a solution to the occurrence of problems in the production process, for example, the cause of the appearance of defects.

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

Consider metallurgical defects that are formed during the smelting of ingots or casting parts. The most common metallurgical defects are: shrinkage and gas cavities, cracks and inclusions, shrinkage cavities - represent a cavity formed as a result of a decrease in the volume of liquid metal during its solidification. The reason for the formation of such a defect is - a decrease in the volume of the metal during solidification of gas cavities - rounded cavities with a diameter of 1 ... 3 mm and more with a smooth shiny surface. The main reasons for the occurrence may be: low gas permeability of the mold and rods; poor processing of refrigerators, etc., cracks - are discontinuities in the form of metal breaks. The formation of cracks in a continuous ingot is associated with stresses arising during its formation,

Inclusions are of two kinds and origin: the inclusion of non-metallic particles trapped in the metal

from the outside (slag, refractory, sand, graphite) and metallic inclusions (ferroalloys, sunken pieces of bars or marking bows, etc.)

Missing defects in the products of Zavod Tekhmash LLC may arise due to a number of reasons related to process control. The main factor affecting the omission of defects is the qualification, certification and training of personnel, as well as the conscientious performance of the NDT operator's work. The most common type of defects is cracks in die-forged parts. A crack is a clear (transparent) discontinuity-discontinuity passing along, or through the grain boundaries. Typically, cracks are caused by local overstraining of the metal during stamping or other shaping operations, or as a result of heat treatment. It is customary to subdivide cracks of such a group into longitudinal, shearing, internal and transverse cracks.

Let us consider, using the example of the products manufactured by OOO Zavod Tekhmash, one of the products most susceptible to rejection, a hoe rotary harrow BMR: The unit is designed for continuous and inter-row processing of any crops, cereals, 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 for combating weeds, incorporating crop residues into the soil.

BMR (Figure 1) allows you to perform a number of different quick jobs that are an integral part of professional soil cultivation. After completing the work, the unit prepares the soil before sowing, the sowing field, the same unit loosens the soil, thus preventing late germination of grain. Loosening also contributes to the even distribution of oxygen and moisture in the soil, thus, contributing to the strengthening and growth of the plant and further making it more resistant to drought. The machine effectively and evenly loosens the soil without damaging the plants. The implement is well suited for both continuous and inter-row cultivation, it has a high frame passage, which allows you to work the soil, even with an already grown plant.



Picture 1 - Hoe rotary harrow

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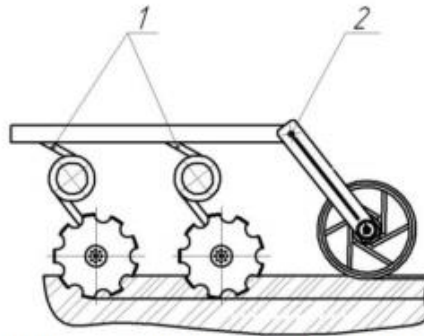
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The unit is designed according to the spring-loaded swing arm scheme. The flexibility of the lever is provided by a spring, which applies pressure to the soil by means of two gears, which are located on one lever and, when rotated, create an explosion effect that loosens the earth without damaging the plant. The row

spacing is adjustable from 10 cm. The unit is produced serially, 6 m with a solid frame, 6 m with hydraulic folding in the mounted version and 12 m in the trailed version.

The most common defect in this harrow is disc wedging (Figure 2).



1 – дисковые рабочие органы на индивидуальных спиральных стойках; 2 – каток

Figure 2 - Schematic representation of an ICBM in profile

Jamming of the rotating disc occurs due to the failure of the bearing assembly. This is due to the fact that for the manufacture of a disk working body, low-quality bearings or bearings that do not correspond to the design of the product are used. As a result of the choice of a bearing that does not correspond to the calculated strength characteristics of the working body, its rapid wear and spalling occurs, due to loads exceeding the permissible for this bearing assembly. A way out of this situation can be the purchase of the highest quality bearings, as well as the correct selection according to the nomenclature of this unit.

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

An invariable defect of the surface of metal and metal products, accompanying heat treatment, is the formation of a decarburized layer due to the burnout of a part of the carbon when the metal is heated for subsequent quenching. Decarburization of the metal surface can take place both at the stages of rolling, preparation of metal for upsetting, and during heat treatment to the appropriate strength class of finished parts. Decarburization and scale formation significantly reduces the mechanical properties in the surface layers of the metal, the surface becomes susceptible to the formation of scratches, scoring, scratches during rolling, calibration, upsetting, and thread breakage is possible during mechanical tests. The use of protective atmospheres during heating significantly reduces 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, product warpage and distortion of the geometric dimensions of

the thread are possible. It is possible to exclude such a defect only by using isothermal quenching in more viscous quenching media.

Quenching cracks in a deformed metal can appear during quenching as a result of the occurrence of high stresses of structural transformation and temperature stresses. Quench cracks usually have an irregular wandering path on the surface of the fastener. The main reasons for the appearance of temperature stresses are: rapid heating for quenching, rapid cooling in the region of martensitic transformation, a complex configuration of a product with abrupt transitions, and a significant time gap between quenching and tempering operations.

Defect control at OOO Tekhmash Plant. During inspection control, the quality of work of the production and control apparatus is monitored. It is carried out by a special commission and employees authorized by the head of the Quality Control Department or higher officials. Items handed over by production personnel and accepted by the relevant employees of the Quality Control Department are subject to control. If a defect is found in individual parts, blanks or other products of labor, the entire batch is subject to re-inspection. The purpose of this control is to discipline both production and control personnel and increase their responsibility for product quality. Inspection control is also used in selective observation of the operation of machines at the consumer's site in order to identify defects in production, design, technology and violations of the rules of technical operation.

Visual inspection is an external examination of an item or product labor, as a result of which deviations from the requirements recorded in technical documents are revealed (external cracks,

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shells, increased roughness, excessive protrusions, concavities, dents, defects in color, installation, shape distortion, etc.).

During geometric control, the compliance of the dimensions of blanks, parts, installation bases and other elements with the dimensions established in technical documents (drawings, standards, technical conditions), as well as in accordance with standards is checked. This type of control prevails in mechanical engineering.

In laboratory analysis, the internal properties and parameters of objects and products of labor are revealed, which cannot be detected visually or without their destruction. The most important point - making a decision on the non-compliance of the product with the requirements and the termination of its operation or functioning - should be specially noted and scientifically substantiated in technology. The

foundation of this decision is pre-assembled statistical material.

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

The number of detected defects in the forging for 2020 is shown in Table 2, and in Figure 3 the constructed Pareto chart for the identified defects for 2020, the expected number of defects in 2021 is given in Table 3, and the constructed Pareto chart in Figure 4

Table 2 - Characteristics of defects identified in the machines of LLC Plant "Techmash" (2020) (pieces)

The name of the defects revealed in the sold machines	The number of detected defects in the sold machines	Accumulated share of detected defects	Total number of detected defects (cumulative percentage)
Bearing failure	17/8	38%	38%
Jammed rotation discs	9/5	20%	58%
Violation of the part hardening technology	5/3	11%	69%
Frame deformation	4/4	9%	78%
Crack Disc	3/3	6%	84%
Other	7/8	16%	100%
Total	45/11	100 %	

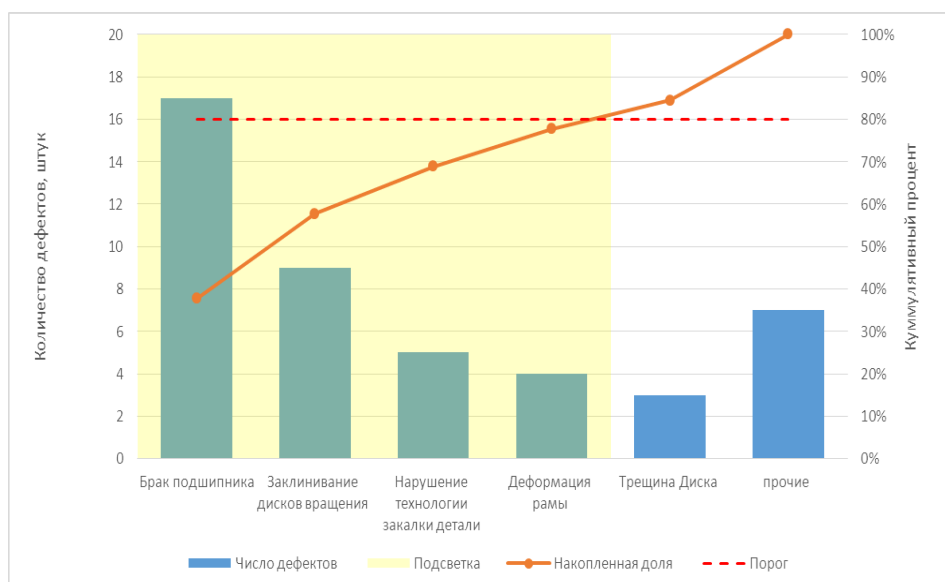


Figure 4-Diagram of defects in products manufactured by LLC "Plant" Techmash "for 2020

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Table 4 - Characteristics of defects detected in machines (2021) (pieces) (expected)

The name of the defects revealed in the sold machines	The number of detected defects in the sold machines	Accumulated share of detected defects	Total number of detected defects (cumulative percentage)
Jammed rotation discs	4/4	38%	38%
Violation of the part hardening technology	3/3	20%	58%
Frame deformation	2/3	11%	69%
Wheel axle deformation	2/2	6%	84%
Crack Disc	1/1		
Other	1/1	16%	100%
Total	13/14	100 %	

Their experience in applying statistical methods of quality control using the Pareto chart has confirmed their effectiveness for the development of measures by enterprises in order to significantly improve the quality of their products, guaranteeing their consumers safety and its relevance.

The software developed by the authors for processing the results of statistical methods of quality control using the Pareto diagram creates the basis for their reliability and guarantees enterprises to ensure their import substitution competitiveness with their products.

The protection of domestic consumers of import-substituting products from falsified and counterfeit, which was introduced by the Ministry of Industry and Trade of the Russian Federation with mandatory marking with identification means and monitoring the turnover of imported products, made it possible to reduce its market share by 10% and return almost 400

billion rubles to the budget of the Russian Federation. But the struggle for the quality of domestic import-substituting products has not become less acute, forcing manufacturers to strictly comply with the requirements of GOSTs and technical regulations. Their experience of using statistical methods of quality control using the Pareto chart for the implementation of these very tasks is presented below based on the results of the studies performed. LLC Plant "Techmash" was founded in 2004. in the town of Shakhty, Rostov region. Today it is an actively developing enterprise in the engineering industry. It is engaged in the production of continuous transport machines (conveyor and conveyor equipment), agricultural tillage equipment, equipment for transportation, storage and processing of grain products (elevators, sugar factories), shaped pipes. Our equipment is designed for agriculture and various industries: food, processing, metallurgy, mining, etc.

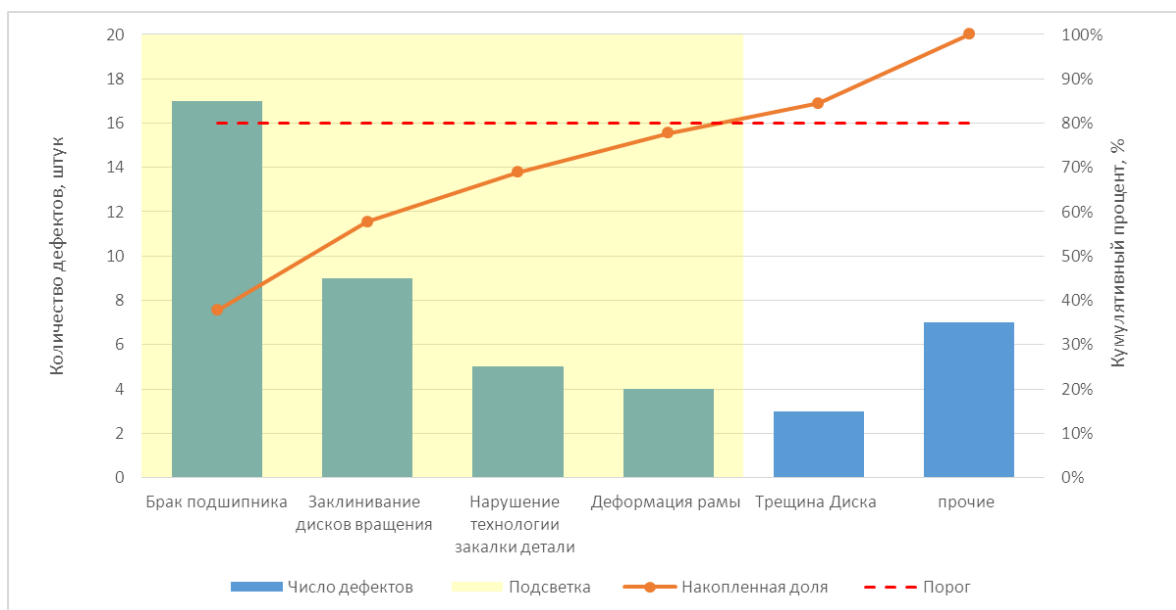


Figure 5 -Diagram for defects in products manufactured by Tekhmash Plant LLC (for 2021) (expected)

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The main principle of the Tekhmash Plant LLC is the production of high quality machinery and equipment that meets modern requirements; an individual approach to solving non-standard tasks of the customer.

Since 2005, OOO Plant Tekhmash has been one of the major suppliers of components for the assembly of combines of OAO KZ Rostselmash with a delivery volume of 20-30 thousand parts per month. In 2020, the activity of the enterprise was expanded: a line for the production (rolling) of straight-seam steel shaped pipes was launched.

Currently, the production facilities of the enterprise are:

- more than 60 pieces of equipment (including those with numerical and digital control);
 - more than 6000 sq. m. production area;
- Employees of Tekhmash Plant LLC are professionals in their field: high-class engineers and designers, technical specialists.

The plant is working on the creation of new models of tillage machines, modernization of the manufactured equipment, in close cooperation with the leading agricultural enterprises in the south of Russia.

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

The workshops of the enterprise are located in a two-storey building. There is a mechanical workshop, a workshop for welding structures, as well as a warehouse for finished products and a warehouse for raw materials and auxiliary materials.

The organizational structure of management is shown in Figure 6.

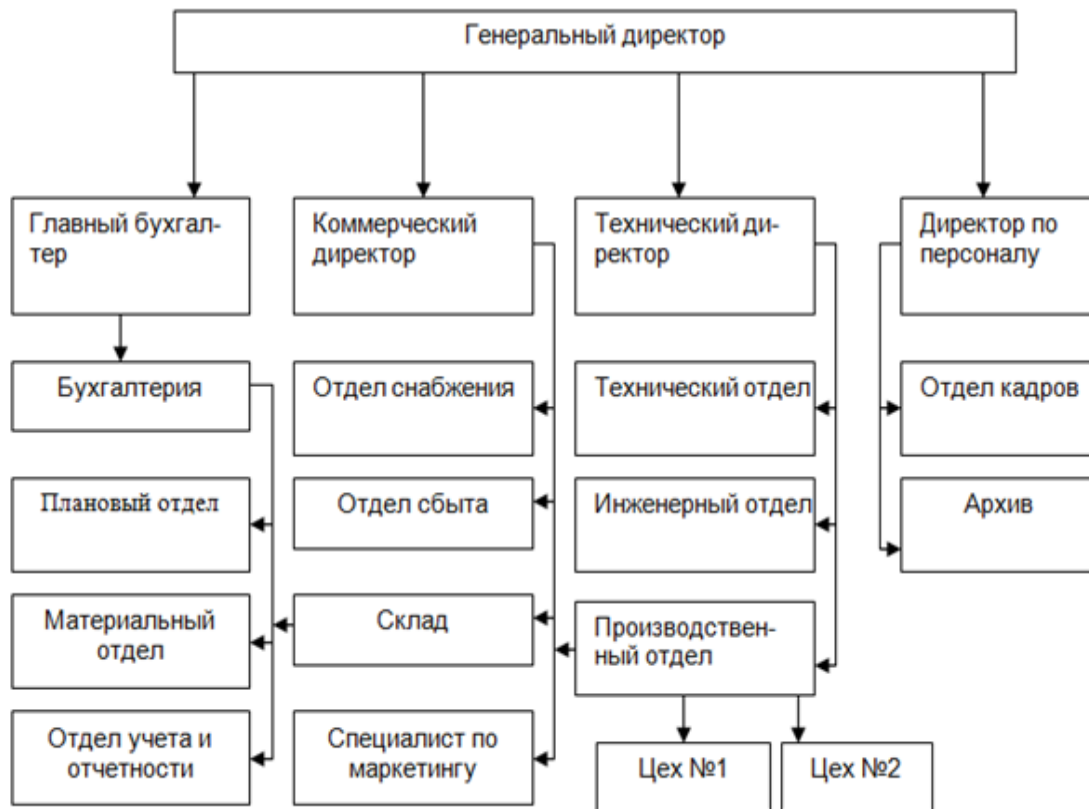


Figure 6 - Organizational structure of management of LLC Plant "Techmash"

The general director is the main responsible person of the enterprise and is responsible for making the overwhelming majority of decisions on the functioning of the company.

The chief accountant is an official of the enterprise who ensures the organization of accounting, control and recording on the accounting

accounts of all business operations carried out by the enterprise, institution, provision of operational information, preparation of financial statements in due time, implementation, together with other divisions and services, of economic analysis of the financial and economic activities of the enterprise its development.

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Procurement manager - an employee who supplies the company with products. He belongs to leadership positions.

Technological Department - This is the unit responsible for the technological resources of the company.

Personnel department - a set of specialized divisions in the structure of the enterprise (with officials employed in them - managers, specialists, technical personnel), designed to manage the personnel of the enterprise.

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

Operators of CNC machines - control of the processing of parts, control of the operation of the machine, correction of control programs.

Tokar - machine operator, specialist in [turning business](#) - [cutting rotating workpieces](#) or [rotating cutting tool](#), for the processing of wood, metal, plastic, etc.

Milling machine- a worker, a specialist in work on a milling machine, a specialist in the processing of various materials: metal, wood, plastic. This profession is one of the leading blue-collar occupations in mechanical engineering and metalworking.

The plant produces continuous transport machines (conveyor and conveyor equipment), agricultural tillage equipment, equipment for the transportation, storage and processing of grain products (elevators, HPP, sugar factories), shaped pipes. Figure 7 shows the range of products manufactured.



Figure 7 - Double-row disc harrow



Figure 8- Four-row disc harrow

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Figure 9- Garden disc harrow BDS



Figure 10 - KPO cultivators



RFigure 11 -Universal stubble cultivator

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Figure 12 - Binary-share plow



Figure 13 - Inter-row cultivator



Figure 14 - Hoe rotary harrow BMR

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Figure 15 - Disc shredder DM

Characteristics of the model shown in Figure 15
Disc harrows PM are intended for traditional and minimal main and pre-sowing soil cultivation for grain, industrial and fodder crops, refreshing soddy meadows and stubble cultivation.

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

Each disc has the ability to adjust the angle of attack and the working width of the disc. At the same time, the disk plays the role of a plowshare and a blade, which contributes to a better turnover of the cut layer, its crumbling, as well as a decrease in the required tractive effort of the tractor. The absence of disc batteries with a single axis in the design allows

the PM to work in wet weather on lands with a large amount of plant residues, as well as on lands with any amount of weeds, while winding on the disc axis and dense clogging of the rows of discs is excluded. There is no need to use scrapers in the design, since the disc self-cleaning occurs during operation.

PM is of particular value in areas of a small area and difficult terrain, where high maneuverability of the machine is required.

The version for orchards and vineyards allows in one type to combine three implements that differ in the width of the processed strip in increments of 275 mm.

Table 5 shows the technical characteristics of the disc harrow

Table 5- Technical characteristics of the disc harrow

Names	Units	The values
Type of		Trailed
Productivity per 8 hour shift	ha	30
Working speed	km / h	8-15
Transport speed	km / h	No more than 25
Soil moisture	%	Up to 35
Capture width	mm	3200
Weight	Kg	2600
Dimensions (edit)		
- width	mm	3200
-height	mm	1350
- length	mm	2550
Number of cutting units in one row	PCS.	8(7)
Cutting units total	PCS	30
Number of rows	PCS.	4
Diameter of working bodies	mm.	560
Distance between discs	mm	400
Distance between rows of discs	mm	700
The angle of attack of the discs	hail	0 to 30
Working depth	cm	Up to 15

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Figure 16 shows the Cutting unit.

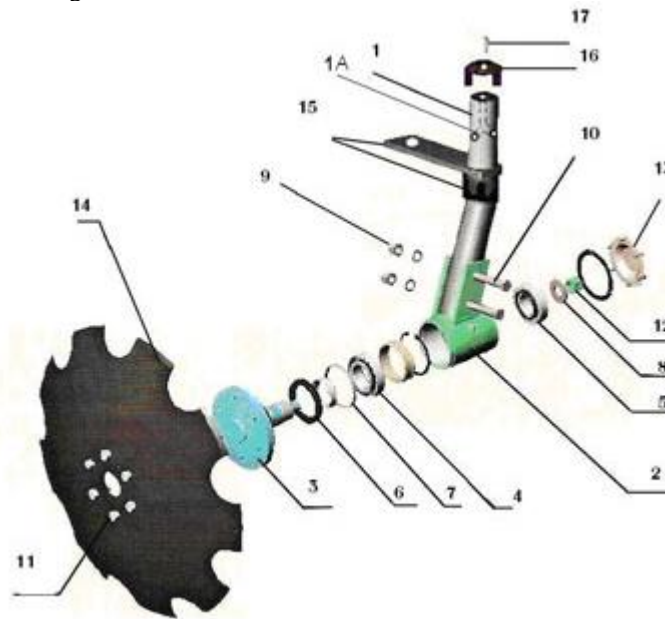


Figure 16 - Cutting unit

The cutting unit is designed for cutting, splitting and turning the layer. It is the main working body of the tool (Figure 16). Consists of a rack 1, to which the bearing unit is attached with two bolts with nuts 9.10. The bearing unit consists of a bearing housing 2 with a grease nipple, bearings 4.5, collar 6, axle 3.

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

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

Organization and implementation of technical quality control is 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 for further processing, forms a production process or production. The main requirements for the quality of products are established by state standards. They set out the requirements for the main parameters and dimensions, the quality of surface treatment, and the design of products. The standards regulate: grades of alloys used for manufacturing. Recommended metal grades as the base coat, base metal and coating thickness; parameters of product surface roughness. The standards contain requirements for strength, set out the principles of acceptance. Defects in appearance, the degree of their admissibility in products are indicated, depending on the type of quantity, size, location of defects and on the total surface area of the product.

The standards also set out the acceptance rules and test methods. They standardize the requirements for packaging, labeling, transportation and storage of finished products.

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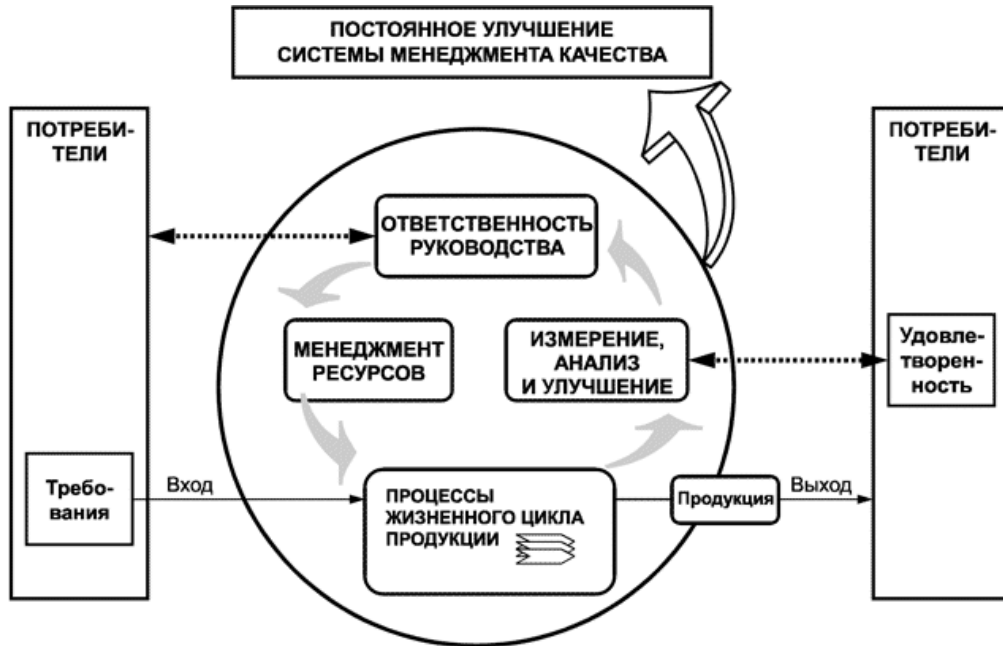


Figure 17 - Process model

As can be seen from the process model, there is a constant improvement in product quality due to the requirements of consumers and the responsibility of management. Products go through all stages of the life cycle and are constantly improving quality due to corrective actions as a result of found discrepancies, which are identified by the quality service. If the product does not satisfy customers, then it is measured, analyzed and improved to meet customer requirements.

Management system of OOO Plant "Techmash", which includes a quality management system based on the requirements of ISO 9001: 2015, an environmental management system based on the requirements of ISO 14001-2004 and an occupational health and safety management system (SMPZiB), based on the requirements of OHSAS 18001-2007 was developed and implemented in 2008. The integrated management system is presented in Figure 18.

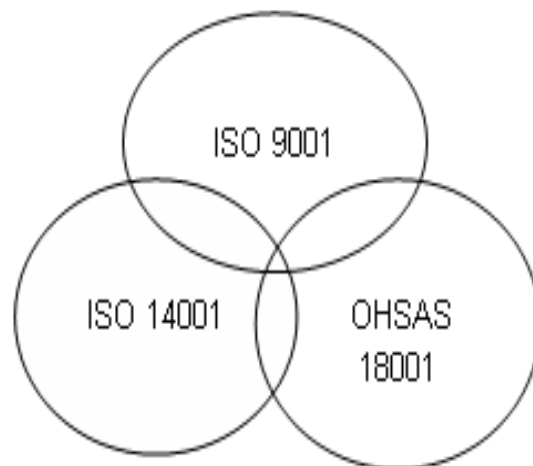


Figure 18 - Integrated management system

The similarity of the structures with the requirements that make up the QMS makes it possible to highlight certain common elements of these management systems:

common elements: a representative of the QMS management; responsibility of management; QMS

policy; resource management; QMS guide;

uniform processes: analysis of the QMS by the management; decision making and action by senior management; planning, development and implementation of measures of a strategic nature in the field of meeting customer requirements; design

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and development; purchases; production and service; uniform procedures: control of documents and records; internal audit of the QMS; monitoring and measuring processes.

Certification of the QMS for compliance with the requirements of international standards makes it possible to increase the competitiveness of the organization, to assure the interested parties in 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.

In order to inform employees about the established requirements and planned activities within the QMS of the plant, documentation has been developed and applied. Documentation management is carried out in accordance with STO SMK 1-04-2011 "Document Management".

The structure of the QMS documentation consists of 4 levels. Level 1 contains documents:

quality, environmental, and occupational health and safety policies, quality, environmental and occupational health and safety objectives statements; programs;

QMS guide; Level 2 contains documents:

documented procedures, the need for which is established by ISO 9001 and the procedures required by ISO 14001 and OHSAS 18001 - STO ISM (STO SMK, STO SEM, STO SMPZiB);

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

Level 3 contains documents:

provisions on structural divisions;

job descriptions;

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

TU, developed by OOO Plant "Techmash", and other internal regulatory and technical documentation developed in accordance with ESKD (Unified System for Design Documentation) and ESTD (Unified System for Technological Documentation);

organizational and administrative documents on QMS issues.

Level 4 contains the records required to demonstrate compliance 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 Guidelines are used internally by Tekhmash Plant LLC in order 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 Tekhmash Plant LLC.

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

The control copy of the QMS Manual is kept in the USM. Recorded copies are issued in accordance with the "List of holders of the" QMS Manual ", are registered and managed in accordance with STOSMK 1-04-2011

"Document Management". Access to the electronic version of the document is provided by posting the Company's QMS Manual on the website of LLC Plant "Techmash".

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

When making changes, the same procedures and rules are applied that are used in the development of the QMS Manual. Changes made to the text are highlighted in italics. After each changed or new section, subsection, paragraph, subparagraph, the annexes give in brackets the information about the introduced change (changes) in bold italics, indicating its number (numbers).

The main goal is to manufacture 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.

Basic principles of OOO Plant "Techmash":

all accidents and accidents can be prevented;

no work should start if it cannot be done safely;

admission to work at HIFs only for persons of

appropriate qualifications;

leadership leadership;

personal responsibility;

systematic approach to management;

partnership with all stakeholders;

risk management approach;

rational use of resources;

staff involvement and ongoing training;

continuous improvement.

The management of OOO Plant "Techmash" undertakes the following obligations:

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

comply with the requirements of the integrated management system of LLC

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

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

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

consult with employees and their representatives on labor protection and industrial safety;

prevent negative impact on the environment.

The management of OOO Plant "Techmash" assumes responsibility for the implementation of the Policy and providing the necessary resources for the effective functioning of the integrated management system.

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

- own safety and health;
- safety and health of others;
- industrial safety;
- product quality;
- environment.

Product monitoring and measurement includes: incoming control of raw materials and materials; quality control and product testing during production (operational control);

operational control;

acceptance control;

final control of finished products (for the construction site);

quality assurance control during intrashop transportation, storage and shipment.

Incoming control - checking the quality of raw materials and auxiliary materials entering production. Constant analysis of the quality of supplied raw materials and materials allows you to influence the production of supplier enterprises, seeking to improve quality.

Control measures or other activities necessary to ensure the compliance of purchased products with the requirements specified in the purchase information are defined in STO SMK 5-11.

Product quality control during the production process includes all types of product control and testing carried out during the technological process (operational control).

Compliance with production technology is a prerequisite and basis for ensuring the desired quality of manufactured products.

Control over compliance with technological discipline is multi-stage and is subdivided into:

- continuous;
- periodic;
- extraordinary

A brief description of the types of control over the observance of technological discipline is given in Table 6

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

Operational control of the production technology is carried out by the technological personnel of the shops and the personnel of the Quality Control Department.

Table 6 - Characteristics of control types

Control type	Step number	Control performer	Periodicity	Control scope
Continuous	I	1. Worker, foreman, inspector of quality control department	During the shift	Execution of operations at workplaces in accordance with technological documentation and control scheme.
Continuous	II	1. Shift supervisor, shift production foreman and QCD foreman, senior production foreman, site manager	During the shift	Compliance with production technology, product quality and materials used, knowledge of ND and TD in 1-2 workers.
		3. Head of the department and quality control department, production foreman and quality control department foreman.	Weekly	Product quality analysis.
Periodic	III	Subdivision commission (shop floor)	Once a month according to the schedule	In accordance with the requirements of clause 6.3. real service station
Periodic	IV	Society Commission	1 time per month according to the schedule	In accordance with the requirements of clause 6.3.1.2 of this STO

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Extraordinary	V	Commission appointed by the top management of the Company	As directed by the top management of the Company	In accordance with the requirements of section 6.4 of this STO
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During operational control, compliance with the requirements of technological instructions, standards, technical conditions and other regulatory documents is checked in accordance with the control scheme for production technology and product quality, then - a control scheme that ensures continuous control at all stages of production.

The results of operational control are recorded by the quality control department controller or a shop worker (in the case of self-control) in the logs or other documentation specified in the technological instructions and the control scheme.

Records based on the results of operational control are kept in accordance with STO SMK 1-03 and must contain the results achieved or evidence of the activities performed.

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

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

Control of the second stage is carried out by senior and shift production foremen, foremen of quality control department, heads of divisions and quality control department. Control is carried out on a shift / weekly basis.

In the process of control at the second stage, the personnel are checked for compliance with the production technology, the quality of products and materials used, the knowledge of the requirements of ND and TD is checked.

Periodic control provides for the third and fourth stages.

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

The control is carried out once a month according to the schedule approved by the head of the unit by the commission consisting of:

chairman - deputy head of the shop (chief specialist);

members - the head of the audited area;

representatives of quality control department, laboratories in the direction, technological service. By the 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 inconsistencies with an indication of the timing of their elimination and executors.

By the decision of the chairman of the commission, for discrepancies affecting the

effectiveness of the quality management system, design documents are developed in accordance with STO SMK 5-05.

The preparation of the commission's work schedule and orders based on the results of inspections is carried out by the deputy head of the workshop.

The assignment of responsibilities for the performance of this work to another manager is formalized by an order for the unit

The fourth stage is carried out by the Commission of the Society.

Control is carried out once a month in one of the divisions. The results of the control are documented by an act, which is signed by the members of the commission and approved by the chief engineer. The preparation of a schedule for checking compliance with the production technology by the Company's commission and acts based on their results is carried out by the technological service. Based on the identified inconsistencies, measures are developed to eliminate them with an indication of the deadlines for elimination and performers. The chairman of the commission determines from the number of identified inconsistencies items that require the determination of the causes of the occurrence and the development of corrective actions to eliminate them. The head of the audited unit is responsible for the development of corrective actions, the development of corrective actions is drawn up as an appendix to the act in the form of a table and sent: the original to the chairman of the commission, copies: to the Deputy Chief Engineer for Technology to the Chief of the Company's Technical Department no later than 15 days after the receipt of the act. One copy is kept in the unit along with the Act.

Control over the implementation of measures to eliminate the identified inconsistencies and corrective actions is carried out at meetings on quality with the heads of departments with a note in the minutes of the meeting.

The heads of departments provide information on the implementation of measures to eliminate the identified inconsistencies and corrective actions for belonging to the TU / TO RMK (copies of protocols, letters).

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

The basis for an extraordinary control over the observance of the production technology are inconsistencies identified in the technological process that require a collective solution by specialists from different departments (for example, mass production of inappropriate products).

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The Commission is headed by the Chief Engineer. The composition of the commission includes: the head of the technical department of the Company, the main specialists in the areas, at the request of the chairman, other persons may also be involved in the commission.

The results of the check are documented by the order of the General Director of OOO Zavod Tekhmash.

Control over the implementation of measures to eliminate the identified inconsistencies and corrective actions is carried out by members of the commission and belonging to the TU / TO RMK.

Acceptance control of products is carried out by employees of the quality control department of the corresponding workshop, workshop employees leading the technological process, if it is provided for by the control scheme, in order to obtain evidence that the products have passed and withstood all the prescribed types of control and tests. For acceptance control, the results of testing samples (samples) are used, as well as measurement and visual inspection of the appearance and quality of the surface.

Acceptance of products is drawn up by employees of the Quality Control Department (in divisions transferred to self-control - the performer of the technological process) and is registered in the forms of records of the established sample provided for this redistribution (passport, technological map, invoice, entry in the journal, shelf sheet).

During the final control, a product conformity assessment is carried out, through which the manufacturing unit ensures and declares that the controlled product meets the requirements applicable to it. For final control, products are presented that are manufactured in accordance with the requirements of ND and TD, agreements (contracts), which have passed all types of control and tests with positive results.

The documents for the presentation of products to the Quality Control Department for final control are in-house invoices, cards for finished products, reports of production operations and other documents specified in the technological instructions.

In case of positive results of all types of control and testing of finished product parameters for compliance with the requirements of ND and TD, agreements (contracts) and the conditions of the order, the control master or responsible for control gives permission for the shipment of products with the registration of the established technological documentation.

The products are not entitled to be sent to the consumer until the procedures provided for by the control schemes and regulatory documents are completed, with satisfactory results obtained, and until the relevant data and documentation are presented for certification.

In the event that any nonconformity is revealed

during product control, the control master, or the person responsible for control, takes measures to organize the elimination of the nonconformity. Further actions with such products are carried out in accordance with STO SMK 5-15-12 "Management of non-conforming products".

The procedure for quality assurance control during intrashop transportation, storage and shipment is carried out in accordance with the production instructions of the units carrying out loading and unloading, storage, packaging and delivery of products in accordance with regulatory documents and contract terms.

Similar to the requirements of ISO 9001-2015 clause 8.1. requirements are indicated:

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

- proof of compliance with product requirements;
- establishing the conformity of the quality management system;
- continuous increase in the effectiveness of the QMS.

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 the in-melt heterogeneity according to OST 14-1-34-90, as well as by comparing the control sample with their key values formulated from the original sample.

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

Compliance of the quality degree of each batch of melt with the conditions of the standards is guaranteed by the production technology, float post-operational control of the technological process, and the acceptance quantity for each quality attribute.

The stability of production technology, product quality indicators are controlled by examining the degree of intra-melt heterogeneity according to OST 14-1-34-90, comparing the main sample with their initial values determined from the base sample.

The adoption of a conclusion on the coincidence of the controlled parameters with the conditions of these standards, technical requirements is carried out by comparing the calculated values of quality features with acceptance figures.

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

The variances, as well as the average value of the

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characteristics in the supplied period, have no right to 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 in-melt heterogeneity, which is determined by the magnitude

of the swing according to OST 14-1-34-90.

Using table 7, an assessment of the existing quality management system at the enterprise is presented.

Table 7 - Assessment of the existing quality management system at the enterprise according to the standard GOST R 9001-2015

Clause of the standard	Name	Note
Clause 5.2.	Improving quality policy	The organization has
P. 6.3	Change planning	Implemented in accordance with standard
Section 8.1	Planning and managing activities during the stages of the product life cycle and services	Carried out in accordance with the standard
Section 8.3	Design and development of products and services	Implemented in accordance with standard
Section 8.4	Management of externally supplied processes, products and services	Carried out in accordance with the standard
Section 8.5	Production of products and provision of services	Implemented in accordance with standard
Section 9.1	Monitoring, measurement, analysis and grade	Held, but not enough
Section 9.2	Internal audit	There are gaps in the organization of the internal audit system
Section 9.3	Management review	There are problems in the system Quality control

Table 8 - Criteria for assessing the effectiveness of management systems based on the results of internal audit

Criteria for evaluation	Balls
Requirements are met in full	9-10
Requirements are met, no discrepancies have been identified, but there are comments	6-8
Requirements are met, no more than 5 inconsistencies and / or no more than 3 recurring inconsistencies are identified	3-5
Requirements are largely not met, more than 5 nonconformities identified and / or more than 3 recurring nonconformities	1-2

Thus, the organization has different control and quality control methods. But the following shortcomings were also identified, such as monitoring, measurement, analysis and assessment is carried out in incomplete compliance with the stated requirements; there are deficiencies in the organization of the internal audit system; There are problems in the quality control system.

In general, the work of the QMS can be assessed as good, since requirements are met, but there are The presented analysis by the management of the IMS does not include the entire completeness of information on the operation of 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 conformity assessment, based on the results of interaction with external stakeholders, including complaints; The presented analysis by the management of the QMS does not include the entire completeness of information on the functioning of management systems: incomplete input information, taking into account the results of internal audit and the implementation of corrective actions based on the results of external audit; there is no complete information on conformity assessment, based on the results of interaction with external

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stakeholders, including complaints; there is no information on the QMS of the branches, on the effectiveness of the functioning of processes, the status of corrective and preventive measures.

The nonconformities identified above must be corrected by the organization in accordance with the requirements of the standard for corrective action, including the assessment of the causes of the nonconformities and measures to prevent their recurrence.

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

At the enterprise, it is advisable to introduce a quality management system based on the standards of the ISO 9001: 2015 series. This will allow:

means, methods, goals of management to focus on quality;

bring a plan of action at the enterprise (record keeping, fulfillment of requirements, organization of work of departments and services);

accurately assign powers and responsibilities, regulate interaction between different departments and specialists;

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

determine the requirements for important processes affecting 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, to reduce losses and reduce the cost of production; to increase the responsibility of all personnel for the results of work;

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

to raise the image of the enterprise; increase the investment attractiveness of the organization;

to increase the profitability of the enterprise; ensure the fulfillment of customer requirements and improve the guarantees for them;

the presence of a quality management system, confirmed by a certificate, is a confirmation of the organization's competence.

Identified problems in the organization of the quality management system in the organization. Hence, in this section, recommendations will be offered 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 the form of table 9.

Table 9 - Recommendations for improving the QMS

Item No.	Recommendations
Clause 5.2.	Update the quality policy. Modernize the QMS manual to include the scope of the system and a description of all enterprise processes.
P. 6.3	Update planning of changes. Amend the document "Document Management", which includes a description of: - management of external and internal regulatory documents, including Regulations, STP, technological instructions, operating instructions, labor protection instructions, regulations on divisions, job descriptions. Expand the documented procedure "Records Management", in which to identify the types of records for the QMS, to determine the place, terms of their storage and withdrawal.
Section 8.1	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 (personnel, external interested parties, including the public, suppliers and consumers of products). Determine the procedure for changing goals in the field of MC. Change the procedure for setting the Quality Objectives, according to which the documented objectives should be adjusted for each department.
Section 8.3	Improve the design of products and services. Upgrade and maintain the instrumentation management procedure.

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Section 8.4	<p>Improve the management system for processes, products and services supplied by external suppliers:</p> <ol style="list-style-type: none"> In order to improve the planning process, develop a quality planning procedure. Update measures to improve product quality. Improve the procedure for analyzing questionnaires, according to the assessment of satisfaction consumers.
Section 8.5	<p>Improve production and service delivery. Develop a procedure that describes the process for managing nonconforming products.</p> <p>Correct the document describing the storage conditions for finished products.</p> <p>The responsibility and authority in the QMS should remain the same, with their entry into the Regulations on divisions, job and work instructions. Bring to the attention of the personnel against signature.</p> <p>Reappoint a representative of the company's management and define his main responsibilities and authorities in the QMS in accordance with the new standard.</p> <p>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 to develop and further maintain the System in an effective state.</p> <p>Determine the requirements for the competence of personnel in accordance with the requirements of the QMS. Appoint representatives and improve the position for personnel in the QMS, including their rights, duties and responsibilities).</p> <p>Include in the training programs topics related to the requirements of the transition to the new international standard ISO 9001: 2015.</p>
Section 9.1	Improve monitoring, measurement, analysis and estimates.
Section 9.2	Correct deficiencies and improve the internal audit of the organization
Section 9.3	<p>Conduct management reviews on a periodic basis.</p> <ol style="list-style-type: none"> Improve the procedure for conducting an analysis of the QMS by top management. Establish more stringent criteria for senior management review in accordance with ISO9001-2015 requirements.

OOO Plant "Techmash" is a leader in the supply of a number of types of metal products for construction and construction. The plant constantly improves the effectiveness of the QMS through the application of policies, goals in the field of occupational health, data analysis, as well as safety, quality, ecology, audit results, corrective, preventive actions, and analysis of the QMS.

At the largest enterprises, such as OOO Zavod "Techmash", quality, ecology, and labor safety are

inseparable parts of management. Management systems are becoming more and more essential for enterprises seeking to become globally competitive. QMS certification for compliance with international standards gives the opportunity to increase the competitive advantages of the enterprise, to prove to the interested parties in the effective solution by the enterprise of the problems of environmental, industrial safety of these industries, problems of labor protection, as well as safety measures.

Table 10 - Analysis of changes in ISO 9001: 2015

ISO 9001: 2008	ISO 9001: 2015
0. Introduction	0. Introduction
1 area of use	1 area of use
2. Normative references	2. Normative references
3 Terms and definitions	3 Terms and definitions
4. Quality management system	4. Organization environment
5. Responsibilities of the parties	5. Leadership
6. Resource management	6. Planning
7. Product release	7. Means of support
8 measurement, analysis and improvement	8. Activities at the stages of the life cycle of products and services

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	9. Performance evaluation
	10. Improvement

Comparison of the old and new standard shows the following data:

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. The additional procedures were reduced, thus, the goal was to simplify the 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 Plant "Techmash" should pay attention to the following aspects in the field of documentation:

ISO 9001-2015 no longer differentiates between the terms "document" and "record", instead the term "documented information" is used.

The new version of the standard no longer uses the terms "documented procedure" and "quality manual"; in the version of the ISO 9001: 2008 standard, the requirements for the storage and protection of documented information are not clearly indicated; in the new version of the ISO 9001-2015 standard, these requirements were explained in more detail.

Thus, at the present time, a quality management system (QMS) has been implemented and documented at OOO Plant "Techmash" in accordance with the requirements of the ISO 9001: 2015 standard. The QMS is maintained in working order and is constantly being improved.

Let us dwell in more detail on the consideration of the documented information management process, implemented at OOO Plant "Techmash", as part of the transition to the new version of the ISO 9001-2015 standard. Currently, the documented information of OOO Plant "Techmash" includes a Quality Manual, procedures, reporting forms / instructions, and records. Internal documented information of the organization includes the following types of documents:

level 1 - documented Mission, Vision, Quality Policy and Objectives, Quality Manual;

level 2 - organization standards, regulations, job descriptions;

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

level 4 - records.

In OOO Plant "Techmash" there are three types of internal documented information:

Documented information registered with the quality control service and having registered registered copies (Quality manual, organization standards, regulations). Management of this documented information is carried out in accordance with clause 5.1.1 ISO 9001-2015;

Documented information related to the field of activity of a particular structural unit and stored in it. Management of this documented information is carried out in accordance with clause 7.5.3.2 ISO 9001-2015;

Freely circulated documented information, 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 canceled by order or order, 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 the QMS of LLC Plant "Techmash". Requirements in external documented information are mandatory. The external documented information of the QMS OOO Plant "Techmash" includes the following types of documents: 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 contribute to compliance with the new requirements of the standard;

it is recommended to appoint a group of responsible persons of up to 5 people from the enterprise (department for management and quality control of the QMS) to improve the QMS for compliance with the requirements of the new standard;

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

change the responsibilities of quality control personnel;

develop a plan for improving the QMS at the enterprise;

improvement of the QMS documentation;

analysis of proposals for improving the QMS;

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elimination of inconsistencies with the new standard;

ensuring that all personnel who affect the results of the organization are trained in the new requirements of the standard;

- definitions of organizational knowledge;
- production of internal audit;
- analysis of activities by senior management;
- preparation for a certified audit;
- certification at the enterprise.

As the analysis of the current standard has shown, LLC Plant Tekhmash has a problem in identifying the root cause and developing corrective actions for inconsistencies in the organization detected in the divisions. Therefore, it is proposed to improve the existing quality management system from the standpoint of improving the procedure for conducting internal audit of QMS documentation.

It is proposed to leave the supporting documentation the same - the Manual on the Integrated Management System in the Field of Occupational Health and Safety, Ecology and Quality of LLC Plant "Techmash", Regulation on the Management of Management Systems, but it is proposed to update them, that is, to sign by the date of the present.

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

Quality Management System Improvement Program:

- stage one - organizational;
- stage two - introduction of elements of the new version of the standard;
- stage three - conducting internal audits of the quality system, control of the work performed.

To perform the stages of improvement, 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 the organization and implementation of work to improve the quality management system should be delegates to top and middle management. It is necessary to outline the goals, objectives, basic principles of the new quality management system for all personnel. The lack of explanatory conversations and training can lead to a decrease in results, in this regard, it is important to involve all personnel in the process of improving the QMS.

Table 10 - Schedule for improving the quality management system

Name of the event	Number of days	Responsibility for implementation and control	Deadlines
Creation of a working group	3	First Deputy General Director - Quality Director	4/3/2022 - 04/05/2022
Work planning	5	Quality advice	04/06/2022 - 04/10/2022
Preparation and holding of meetings for the assessment of the QMS	5	Service chief Quality control, chief engineer	04/11/2022 - 04/15/2022
Customer and customer satisfaction surveys	7	Assistant General public relations director	04/16/2022 - 04/22/2022
Analysis customer needs, staff, suppliers, etc.	3	Head of Quality Control Service, PRK	04/23/2022 - 04/25/2022
Analysis of the current QMS	4	Quality Director, Head of Control Service quality, chief engineer	04/26/2022 - 04/29/2022
Analysis of suggestions for improvement	3	Head of Quality Control Service, Chief Engineer	04/30/2022 - 2.05.2022
Improving the plan for monitoring and analysis of changes	5	Head of Quality Control Service	05/03/2022 - 05/07/2022
Modernization of the plan for Responding to possible risks	3	Head of Quality Control Service	05/08/2022 - 05/10/2022

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Planning Achieving quality objectives	5	Head of Quality Control Service, BSMK	05/11/2022 - 05/15/2022
Identifying suitable resources	5	Service chief Quality control, BSMK	05/16/2022 - 05/20/2022
Conducting training on a new quality standard	7	HR Director, Head of Service quality control	05/21/2022 - 06/27/2022
Analysis of activities with leadership side	4	Director of quality	05/28/2022 - 06/31/2022
Internal audits	14	Head of Quality Control Service, BSMK, at Support from the specialists of LLC "Audit-Optim-K"	1.06.2022 - 06/14/2022
Eliminate inconsistencies	8	Head of Quality Control Service	06/15/2022 - 06/22/2022
Preparing for a certification audit	10	Quality Director, Head of Quality Department, LLC specialists "Audit-Optim-K"	06/23/2022 - 2.07.2022
IMS certification in accordance with the requirements of ISO9001: 2015	14	Representatives of the group's certification company Bureau Veritas (accompanied by an audit by LLC specialists "Audit-Optim-K"	07/03/2022 - 07/16/2022

Measures to improve the quality management system are very laborious and take a lot of time to implement all stages. The role of preparation and conduct is assigned to top and middle management. The CEO is the main responsible person for the implementation of the implementation of the new improved quality management system. He gives

assignments to responsible persons for the implementation of the modernization of the QMS and monitors its implementation, moreover, the responsibility for the progress of the process is assigned to the Deputy General Director for Quality, who reports to the General Director on the progress of the procedures.

Table 11 - Plan for the improvement of internal regulatory documents in accordance with the requirements of ISO 9001: 2015

Title of the document	ISO section	Type or form of the document	Responsible for development	Completion date
Start order The process of improving the QMS and the distribution of responsibility for the improvement procedure QMS	Clause 5.2	Order	QMS management representative	April2022 April2022
Changes to the provisions on divisions, officials instructions, in 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 QMS development Changes to instructions	Head of the department of organizational work Head of HR Department Head of Legal Department Representative QMS manuals	

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Regulation "Planning in the QMS" based on the ISO 9001-2015 standard	Section 8.1	Regulations	QMS management representative Head of Economic Planning Department	April 2022
Suggestions for Inclusion in quality objectives	Section 8.3	Suggestions for purposes	Representatives for divisions	April - May 2022
Regulation "Management of nonconforming products"	Section 8.4	Regulations	Head of Resource Planning and Product Quality Department QMS management representative	May 2022
Quality Strategic Objectives	Section 8.5	Strategic Objectives	Representative QMS guidelines	May - June 2022
Regulation "QMS Guidelines" based on the new ISO standard 9001-2015	Section 9.1	Regulations	QMS management representative	June 2022
Lists of records by each unit	Section 9.2	Lists	Leaders subdivisions	June 2022
Change Completion Order QMS documentation in accordance with ISO 9001-2015	Section 9.3	Order	General manager	June - July 2022

This plan is approved by the general director of the enterprise. Improving the qualifications of personnel for an enterprise that has embarked on the road of improving quality should be 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 general director 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. The training involves both the personnel of the enterprise, including third-party specialists.

The leadership stimulates the development of personnel qualifications by introducing additional allowances in wages, for the direct acquisition of professional skills in those areas of activity that are officially declared by the authorities as "unmet needs." A list of the skills and abilities that the company needs, the means of proof of their acquisition, as well as their percentage of the salary increment, is compiled annually, and is also brought to the attention of the organization's personnel. The indicated markup reaches up to 30%. Each staff

member needs to have a personal development plan. The passage of training is taken into account during the current certification of managers and specialists.

To increase efficiency, different benefits should be used on quality management, reminders for employees, engineering and technical personnel on the quality system. These guidelines disclose the goals, objectives of the enterprise in the field of quality, the structure of the QMS, the responsibilities and rights of personnel in solving problems in the field of quality. For the formation of such benefits, both employees of the enterprise and third-party specialists are mobilized.

Certain needs and expectations of consumers must be accompanied by the QMS, implemented at all stages of its improvement.

Attention should be paid on setting the expectations of consumers as well as other interested parties. Taking into account such expectations in the QMS allows us to provide hope for a guarantee that it will not in any way become obsolete in the near future. This makes it possible to take, maintain a leading position in its own market area. To assess these expectations, one should use or make forecasts of the development of consumer needs and educational services.

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The document "Mission, policy, goals and objectives in the field of quality" is the main document of the quality management system, since it establishes the main objectives of the enterprise in a concentrated form, gives a clear idea of its mission, its long-term goals and positioning itself in the market. Improving the quality management system is a complex of works that affects various aspects of the enterprise and its subsystem - 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, lengthy and laborious task. And it consists of several stages.

Process maps have been developed for each department, division and department of the enterprise and are presented in the form of table 12.

Table 12 - Process map

Process name	Responsible for the process	Purpose of the process
Financial management	Head of Financial Department	Planning, analysis and control of budget execution of the need for financial resources for the implementation of production, investment and social programs
Delivery process	Sales Manager	Delivery of finished products of the enterprise in the appropriate volume and within the appropriate time frame
Accounting	Deputy chief accountant	Formation of complete and reliable reporting on activities and its property status, to monitor compliance with the legislation of the Russian Federation in the implementation of business transactions and their feasibility, the presence and movement of property and obligations in accordance with the approved standards.
Management review	Director of quality	Assessment of the effectiveness of the QMS
Production of products	Technical Director	Implementation of planned indicators
Product control and analysis	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 Service	Ensuring the fulfillment of the transportation plan, timely delivery and cleaning of wagons to loading and unloading fronts.
Providing the enterprise with the necessary technical documentation for the 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
Business management of the enterprise	Head economist	Organization of planning and analysis of economic activities of the enterprise

The top management of the enterprise must ensure that the quality objectives, including those necessary to fulfill the requirements for the product, have been established in the relevant departments and at their respective levels. Quality objectives should be measurable and consistent with the quality policy.

Objectives are the objectives of the organization to improve the quality of work, expressed numerically.

Since, when implementing a QMS, the organization also distinguishes processes that describe the work of the organization, then we can say that

quality objectives 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 system development 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, measure and document the processes. Table 13 presents the monitoring and measurement of QMS processes.

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Table 13 - System of indicators for measuring QMS processes

Process	Target	Result	Indicators for evaluating the process and its result (performance criteria)	Who measures, frequency of assessment
Compliance with the requirements of the QMS	Execution of the production plan	Achieving 100% of the result	Compliance of QMS processes	Head of Quality Control Service
Taking corrective action	Lack of marriage	Achieving 100% of the result	Number of corrective actions	Head of Quality Control Service
Execution of applications for the production of products on time	Achievement of planned targets	Achieving 100% of the result	Amount of processed orders	Head of Quality Control Service
Implementation of the grade plan	Achievement product grades	Achieving 100% of the result	Number of product varieties	Head of Quality Control Service

To improve the quality management system in the organization for compliance with the requirements of ISO 9001-2015, an improvement in the internal audit of the QMS is required. To maintain the quality management system (QMS) of the enterprise in working order and to continuously improve the efficiency of its functioning, it is necessary to constantly improve and improve all the processes of the organization. When identifying priority areas for improvement, it is important to leverage the benefits of the internal audit process. Internal audit is the main tool for assessing the effectiveness of the use of the quality management system. ISO 19011 defines audit as a systematic, independent and documented process for obtaining audit evidence and evaluating it objectively in order to determine the extent to which agreed audit evaluation criteria have been met. 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 (checks) of the QMS are usually carried out 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 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 you to solve the following tasks:

- analysis and elimination of the causes of the identified inconsistencies;

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

- assessment of the effectiveness of a functioning management system;

- preventing the appearance of quality problems;
- establishing the degree of understanding of the personnel of the goals, objectives and requirements described by the documents of the management system;

- 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 is the allocation of responsibility and authority for the implementation of internal audit in the organization.

The organization's management ensures the independent conduct of internal audit and analysis of the QMS. Owners, participants and interacting in the process of internal audit and its stages are reflected in the matrix of responsibility (table 14).

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Table 14 – Matrix of distribution of responsibility by stages of the procedure "Internal audit of management systems"

Stages	Responsible persons						
	Managing director						
	Leadership Representative						
	Technical Director						
	USM						
OSMiS							
						Audit Team Leader	Head of the audited unit
1 Development of a draft annual program of internal audits of the IMS	AND	WITH	WITH	V	V	AND	
2 Approval of the annual program	AND	R	R	WITH	WITH	AND	AND
3 Preparation of internal audit plans				V	V	AND	
4 Approval of internal audit plans		R	R	WITH	WITH		AND
5 Preparing information on audited units and holding a meeting with audit team leaders				V	V	AND	WITH
6 Preparing the audit team				WITH	WITH	V	WITH
7 Conducting a preliminary meeting in the auditee						V	WITH
8 Collection and verification of information				AND		V	WITH
9 Conduct a closing meeting						V	WITH
10 Registration of audit results				AND		V	AND
11 Development by the correction / design department				WITH	WITH	AND	V
12 Assessment of CA for sufficiency				V	V	AND	AND
13 Performing correction / CD						AND	V
14 Checking the execution of CD		AND	AND	WITH	WITH	V	WITH
15 Assessment of the effectiveness of CA		AND	AND	AND	AND	V	AND
16 Analysis of the results of audits and the implementation of the IMS internal audit program at the end of the year	AND	AND	AND	V	V	AND	AND

Legend:

- R responsibility for making a decision;
- V responsibility for implementation;
- WITH responsibility for assistance;
- AND receiving the information.

Suggestions and recommendations on the organization and conduct of internal audit contribute to improving the efficiency of the internal audit process and the internal control system as a whole. Improving the effectiveness of internal audit largely depends on the correct organization of its work. Internal audit provides audit evidence. It is important that the evidence obtained is objective, as it can influence decisions regarding the achievement of the goals and objectives of the enterprise as a whole and

its divisions. Also, during the internal audit, errors and inconsistencies are revealed that can affect customer satisfaction. With regard to the internal audit process, the following inconsistencies were identified: the audit of the technical control department was not carried out and is not included in the audit program.

The division is highlighted 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 have not been confirmed. Submitted certificate of training for the course "Internal Audit" (attended a theoretical course) was without any positive results of this training (testing).

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Table 15 - Measures to improve the internal audit of the QMS in the organization

Disadvantages of conducting internal audits of the QMS	Measures to improve internal audits of the QMS
Lack of competence of the audit team	Revise the register of internal auditors, train new auditors, organize quarterly round tables, replenish the library with specialized literature on quality assessment.
Lack of motivation for the audit team	Increasing the motivation of the audit group of the enterprise due to additional priming based on the results of work
Changes to requirements for internal audit in accordance with GOST R ISO 9001 version 2015	Improving documentation
The audit of the technical control department has not been carried out and is not included in the audit program. The division is highlighted 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.	Conduct an audit of the technical control department with inclusion in the internal audit program
There is no evidence by which to assess the extent to which planned activities have been completed	Implement evidence for assessing the degree planned internal audit activities

Based on the results of the analysis of the QMS by senior management, it was noted that more than half of the selected improvement areas planned for 2019 were not implemented for subjective reasons. There is also no evidence by which to assess the extent to which the planned activities have been completed. There is a psychological problem at the enterprise: the staff is “afraid of the audit”. In addition, auditors included in the register of auditors of the enterprise quite often refuse to conduct an audit, referring to their employment. In this regard, the audit group is not formed, and the audit is carried out by one person, as a rule, a QMS specialist.

Improving the IA process should start with analyzing existing problems and identifying the causes of their occurrence using modern quality tools. The brainstorming method has identified many sub-causes for each root cause.

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 team, lack of motivation for the audit team, imperfection of the standard for internal audits.

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

As part of increasing the competence of the audit team, a methodology for assessing the competence of internal auditors has been developed, which presents a scoring assessment of competence (Table 16).

Table 16 - Criteria for assessing the competence of internal auditors

P / p No.	Requirement	Criteria for evaluation	Points
1	Education	Higher	3
		Secondary special	1
		Average and below	0
2	work experience	More than 5 years	3
		1 to 5 years old	1
		Less than 1 year	0
3	Special training in the basics and principles of quality management	There is	2
		No	0

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4	Special training in internal audit of quality management systems	There is	5
		No	0
5	Experience in conducting QMS audits	More than 5 audits	5
		1 to 5 audits	1
		No	0

Employees with higher education in the areas of "Quality Management" and "Standardization, Certification" receive 10 points. The score for the internal auditor is at least 9. The score for the chief auditor is at least 12. The 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 technique allows you to select auditors in the most objective way, which, in turn, will affect the improvement of the IA quality. It is proposed to develop a document "Auditor's Passport", which will record information on the competence of internal auditors. In addition, the following recommendations were given to improve the competence of auditors: revise the register of internal auditors, train new auditors, organize quarterly round tables, and replenish the library with specialized literature on quality assessment. To increase the motivation of internal auditors, a remuneration system for auditors has been introduced.

As part of improving the standard on internal audits, the IA management procedure was improved, the forms of documents were brought to a single form. As a result of the design, a block diagram of the internal audit of the organization's management systems was developed. The items "Type and serial number of the audit", "Time of the audit in place", "Basis", "Send the audit report" have been added to the internal audit program. Clauses have been added to the internal audit report

"Base", "Recommendations", "Audit Criteria". Developed by measures to improve the internal audit process make it possible to rationally use the resources of the enterprise for the performance of checking the state of the QMS, have a positive impact on the efficiency of the organization's processes, which guarantees an increase in the quality of products.

Normative and organizational - legal documents regulating the process:

- GOST R ISO 19011;
- regulations on the quality management department;
- job description of the head of the quality management department;
- instruction on the activities of the head of the group of the quality management system;
- instruction on the activities of internal auditors for the quality management system;
- instructions on the activities of the management representative - responsible for the quality management system;
- instruction on the activities of structural units authorized for quality.

Development of a document for the coordination of 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 analyzing, reducing and eliminating risks.

The section should contain the following points:
 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;

determination of powers in the working group; determination of risk assessment methods, risk management methods;

assessment of the results of the work of the working group - defining the scope of identification and analysis of risks associated with the quality of products or services.

Table 17 - Risk assessment

Risk type	Cause	Risk severity assessment	Estimating the likelihood of occurrence	Risk type	Adjustment of activities
Technological risk	Decrease in production volumes	2	2	2	Compliance with the requirements of project documentation.

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Commercial and procurement risks	Refusal of suppliers to conclude contracts.	1	1	3	Diversification of production by expanding the number of ready-to-use technologies and types of products.
Risk buyer's refusal from the products he received (return)	Non-compliance of products with quality requirements.	1	1	2	Horizontal integration, i.e. agreements with competitors on a kind of Separation of spheres of influence.
Transport risk	Difficulty getting insurance casco and cargo	1	1	3	Choosing a reliable insurance company.
Technical risks	Problems in the supply of technical materials, low qualifications of workers	2	2	2	Professional development of personnel through education, on-the-job training, efficiency applications for purchase of technical components.
HR risks	Wrong directions in the choice of personnel policy.	1	2	1	Modernization of internal control systems, a program for building staff loyalty.
Risks in making management decisions	Incorrect construction long-term and short-term tasks for development enterprises	2	1	2	Adjustment of strategic objectives based on identified development problems

Table 18 - Scale for assessing the likelihood of risk occurrence

1	Low probability, problem may occur approximately once a year
2	Medium chance, problem may occur approximately once a month
3	High probability, the problem may occur approximately once a week
4	Part of normal practice, the problem comes up all the time
5	To a certain extent, it increases the cost of resources for the execution of the process, but does not affect its output
6	Significantly increases the cost of resources for the execution of the process or somehow worsens the characteristics of the output of the process
7	Significantly degrades the output characteristics of the process
8	Prevents the normal functioning of the process

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Table 19 - Type of risk

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

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

- table "Identification and assessment of risks";
- risk assessment matrix;
- register of acceptable, justified, 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 to get comparable bottom line results.

Applying the risk analysis methodology, the audit can be carried out as follows:

The head of the department (authorized for quality) identifies potential nonconformities, conducts a risk assessment (drawing up a protocol), and conducts a plan and implementation of actions in order to reduce risks.

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

- whether potential nonconformities have been taken into account;

whether the possible consequences are indicated in the correct size;

the correctness of the assessment of the severity of the consequences;

whether the cause of the possible non-compliance has been identified;

the scope of measures to reduce the risk;

implementation of planned activities;

the effectiveness of these activities;

whether the results are taken into account in the processes, instructions.

Modernization (bringing the organization to meet the requirements) of the QMS in accordance with ISO 9001-2015 is determined by the competence of the company that provides consulting and conducts all preparatory work for certification in the organization. Various details prior to certification work in an organization can significantly reduce the capital cost of implementing a QMS. You can specify the following major one-time expenses for the organization. A general description of possible works and an approximate cost ratio of cost items are shown in Table 20.

Table 20 - One-time costs for quality management system improvement and ISO certification

Cost item name	Amount, thousand rubles	Share,%
Internal auditor training	135	13.22
Survey of the organization to obtain recommendations for the implementation of the new standard ISO 9001-2015 quality management system	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) QMS documents	110	10.77
Organization of an advisory body in the field of quality	22	2.15
Customer and customer satisfaction surveys	eighteen	1.76
Training of employees on changes in the organization and new documents of the system	33	3.23
Internal audit of the quality management system	77	7.54
Elimination of remarks identified at the stage of internal audit	88	8.61
Preparing for a certification audit	56	5.48
Certification audit	440	43.09
Total	1021	100

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The current costs here will also include the opportunity costs, somehow lost profit (revenue, alternative income, etc.) that may arise from an alternative investment of funds. The main items of

current expenses accompanying the processes of maintaining the QMS in working order in order to prolong the validity of the certificate are shown in Table 21.

Table 21 - Current expenses of the organization associated with the extension of the validity period of the certificate of conformity to the standard

Cost item name	Amount, thousand rubles	Share, %
Internal audits of the quality management system (at least once a year)	250	25
Training of certified internal auditors	100	ten
Professional development of personnel (training) on quality management issues	50	5
Supervisory audits of the quality management system	600	60
Total	1000	100

Total costs for implementation will amount to 1,021 thousand rubles, then the current costs for the operation of the QMS system will be 1,000 thousand rubles. in 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 not simple. The

difficulty is compounded by the implicit nature of most of the positive effects of improving QMS. For an approximate calculation of the magnitude of such effects at the stage of justification, it is necessary to use expert probabilistic estimates of the possible consequences of improving the system.

Table 22 shows the main directions of obtaining economic benefits when improving the QMS.

Table 22 - Economic effects of improving the QMS

Economic effect type	Effect source
Profit growth proportional to the increase in sales volumes	Expanding long-term relationships with consumers
Savings on fixed costs, proportional to their share in the cost structure and growth in sales volumes	Increased demand from consumers
Reducing total running costs	Optimization of business costs
Relative increase in revenues while maintaining the same level of operating costs	Optimization of processes in the organization by searching for internal reserves

Thus, in general, economic feasibility is understood as a positive reduced cash flow from the moment of investment in the QMS until the moment in the future - the horizon for planning work in the field of quality.

The project was created to carry out improvements in accordance with the ISO 9001-2015 standard.

- Goals:
- successful implementation of ISO9001-2015 improvement;
 - increasing the efficiency of the QMS;
 - bringing the system into compliance with the requirements of ISO 9001-2015 for passing internal and external audits.

- Internal improvement work includes:
- work planning;
 - creation of a Working Group;
 - performance of work according to the work schedule;
 - control over the timing and quality of work.

The result of the economic effect is very significant when a new standard is introduced into the work of the enterprise's 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 you know, the Pareto diagram can be, in particular, used to develop recommendations for optimizing production and economic activities. To solve all kinds of problems associated with 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, the receipt of complaints, a Pareto chart is used.

The construction of a Pareto chart begins with the classification of emerging problems according to individual factors (for example, problems related to marriage; problems related to the operation of equipment or performers, etc.) Then the collection and analysis of statistical material for each factor follows

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in order to find out which ones of these factors are prevalent in solving problems.

With regard to the construction and use of a Pareto chart, the following can be recommended:

- it is advisable to use different classifications and make a lot of 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 data until a few, but essential factors are identified, which, in fact, is 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 fell into one group, which means that a different classification principle should be used;

- if the data can be represented in monetary terms, it is best to show this on the vertical axes of the Pareto chart. If the existing problem cannot be estimated 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 chart is regarded as an effective means of solving problems, only a few essential reasons should be considered. However, the elimination of a relatively unimportant cause in a simple way can serve as an example of an effective solution to the problem, and the acquired experience, information and moral satisfaction can have a beneficial effect on the further procedure for solving problems;

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

In a rectangular coordinate system, equal segments corresponding to the factors under consideration are laid along the abscissa axis, and the value of their contribution to the problem being solved along the ordinate axis. In this case, the order of the factors is such that the influence of each subsequent factor located on the abscissa decreases in comparison with the previous factor (or a group of factors). The result is a chart whose bars correspond to the individual factors that are causing the problem, and the height of the bars decreases from left to right. Then a cumulative curve is constructed based on this diagram.

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

Suppose we have activity data.

The data is not ordered, therefore, first of all, let's sort the data in descending order of profit and the number of defects.

To do this, select the table and select in the tab bar Data -> Sort and Filter -> Sort:

Additionally, we added several columns to the table:

- Increasing profit percentage,% - each product is summed up with the previous one and the total share in the profit is shown;

- Efficiency ratio - in this case 80% (according to the Pareto rule);

- Highlighting criterion - the main defects will be highlighted in the final diagram, we indicate a value obviously greater than 1...

Now let's transform the graph into a more convenient form. Select the row "Increasing percentage of the number of defects,%" and transfer it to the secondary axis (right-click on the row, select Format data series -> Row parameters -> Along auxiliary 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 the series)

Further, we carry out similar actions for the "Coefficient" series, which we transfer to the auxiliary axis and make it a horizontal line.

Let's add highlighting to the diagram, which shows which specific product groups bring the main profit. Select the row

"Highlight" and transfer it to the secondary axis. Set the side gap to 0 - right-click on the row, select Format Data Series -> Row Parameters -> Side Gap

We customize the chart at our discretion and get the final look of the Pareto chart in Excel. But in this program, the author identified errors, not accuracy and coincidence, which distorted the final results and did not allow them to be used, although the Pareto diagram made it possible to distribute the efforts of researchers to resolve emerging problems and establish the main factors with which research should be started 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:

- what problems need to be investigated (eg defective products, money losses, accidents);

- what data needs to be collected and how to classify them (for example, by the types of defects, by the place of their occurrence, by processes, by machines, by workers, by technological reasons, by equipment, by measurement methods and measuring instruments used; not common signs are combined under the general heading "other");

- determine the method and period of data collection.

Stage 2. Development of a checklist for data registration with a list of the types of information collected.

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

Stage 4. Development of a table for checking the data with columns for the totals for each checked feature separately, the accumulated sum of the number of defects, percent of the total and accumulated interest (table 23).

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Stage 5. Arrangement of the data obtained for each checked attribute, in order of importance and filling in the table (table 23).

Table 23 Results of registration of data by types of defects for the construction of a Pareto chart.

Types of defects	Number of defects	Accumulated number of defects	The percentage of the number of defects for each feature to the total amount	Cumulative percentage,%
Deformation	104	104	52	52
Scratches	41	146	21	73
Sinks	twenty	166	ten	83
Cracks	ten	176	5	88
Stains	6	182	3	91
The gap	4	186	2	93
Other	fourteen	200	7	100
Total	200	-		

The group "others" should be placed in the last line regardless of its numerical values, since it is a set of characteristics, the numerical result for each of which is less than the smallest value obtained for the characteristic highlighted in a separate line.

Stage 6. Drawing horizontal and vertical axes.

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

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

Stage 7. Building a bar chart.

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

Step 9. Drawing on the diagram of all designations and inscriptions concerning the diagram (name, marking of numerical values on the axes, the name of the controlled item, the name of the diagrammer), and data (the period of information collection, the object of research and the place of its conduct, the total number of objects of control).

After identifying the problem by building a Pareto chart based on the research results, it is important to determine the causes of their occurrence. This is necessary to solve it. When using a Pareto chart to identify performance and causes, the most common method is ABC analysis.

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

1. Group A - the most important, significant problems, causes, defects. Relative percentage of group A in the total number of defects (causes)

usually ranges from 60 to 80%. Accordingly, the elimination of the causes of group A has a high priority, and the related activities are the highest efficiency;

2. group B - reasons that in total have no more than 20%;

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

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

1. Step The 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 is determined by the step specified for the right ordinate, namely, equal to 10%. And their number for the left ordinate axis is set by 10 equal values. But these values, that is, the step, is taken scaled, namely, 1: 1, 1: 2, 1: 5, 1:10 or 1: 1, 2: 1, 5: 1, 10: 1 and 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 largest. If, for example, 77, then the nearest number is 100. Since the step will be 10. And this corresponds to 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 2. If the value is 40, then the step will be 5. Although it is allowed to use a scale of 1: 4 or 4: 1, but it is better do not use them. Scaling is an important point in the formation of an algorithm and design of a software product for building a Pareto diagram. The abscissa axis is formed by the number of detected defects, but preferably no more than 10, and is formatted with the A4 sheet width. At the same time, authors can choose a book or landscape format. But in any case, the abscissa axis is formed along the width of the sheet. Another condition that must be met when constructing a Pareto chart is that the value of other defects, taken out in their total number, must be less than or equal to it. The formation of the ordinate axis encounters difficulties if the step needs to be set less than 1.0, that is, 0.2 or 0.5 - the software product in this case does not form the axis using the specified step, it may be

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necessary to use the step designation as 2, or 5, but we could not check this version.

The program for the improved construction of the Pareto diagram for statistical research for the purpose of product quality control is designed to solve all kinds of problems associated with 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, the receipt of complaints, etc.

The construction of a Pareto chart begins with the classification of emerging problems according to individual factors (for example, problems related to marriage; problems related to the operation of equipment or performers, etc.). This is followed by 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 use of a Pareto chart, the following can be recommended:

- it is advisable to use different classifications and for each of them draw up your own Pareto chart;
- the specific weight of the group of factors "other" should not exceed 10% of the total number of manifestations;
- it is possible to use the Pareto chart in the case when the frequencies of the manifestations of factors

are replaced by monetary amounts (for example, the values of the lost profit);

- if an undesirable factor can be eliminated with a simple solution, this must 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 laid 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 does not increase in comparison with the previous factor. The result is a diagram, the columns of which correspond to the factors under study, and the heights of the columns decrease in a non-strict sense. Then a cumulative curve is constructed based on this diagram.

The Pareto chart allows you to identify 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 following diagram, they correspond to the green columns).

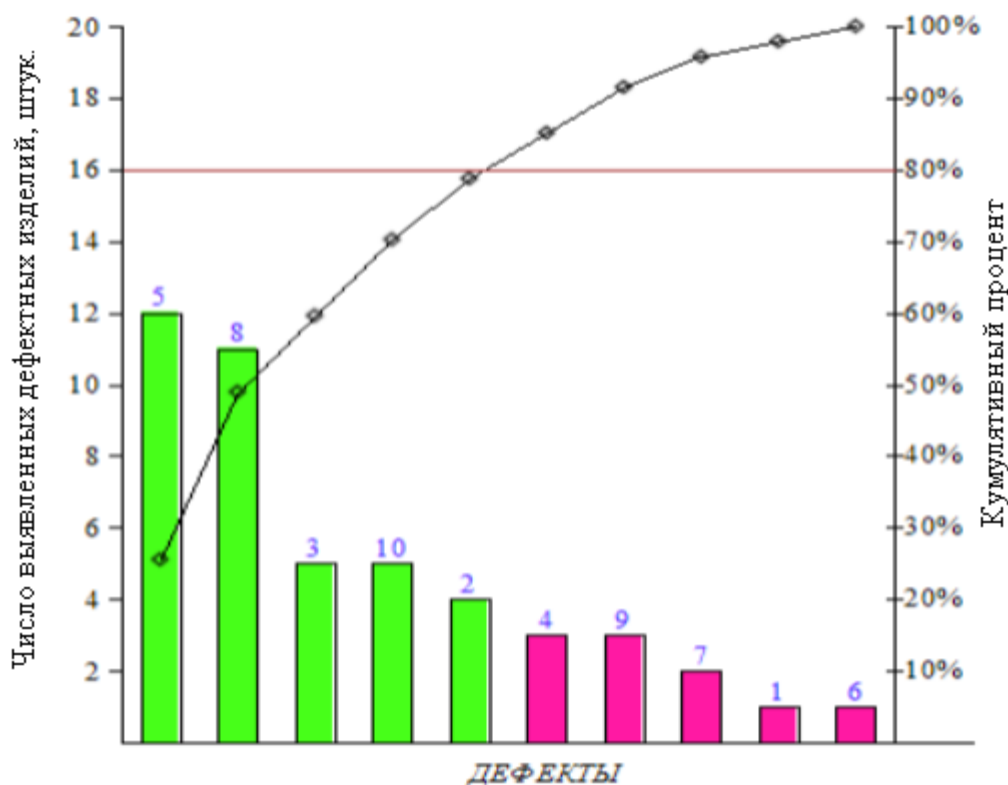


Figure 20. Example of calculation for 10 defects.

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On the algorithm for constructing a Pareto chart.

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

I. We sequentially calculate the values $\tau_j = \sum_{i=1}^n \text{sign}(1 + \text{sign}(p_i - p_j))$, $j = 1, 2, \dots, n$;

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

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

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

II. We build on the plane a rectangular Cartesian coordinate system 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 GO) and plotted from some two points on the GO, which are sufficiently distant from each other. All columns of the Pareto chart will be located between the vertical axes and adjoin the GO from above. Let us describe the position of these columns on the GO. 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 - LVO) and the first column, as well as between i -th column and right vertical axis (RVO) - equal to. Let us take the points of intersection of the air defense and air defense with the HE, respectively, as zero and one on the HE. $n\varepsilon; \frac{\varepsilon}{2}n\varepsilon + (n-1)\varepsilon + 2 \cdot \frac{\varepsilon}{2}2n\varepsilon = 1 \Rightarrow \varepsilon = \frac{1}{2n} \cdot \left[\frac{\varepsilon}{2} + 2(j-1)\varepsilon, \frac{3\varepsilon}{2} + 2(j-1)\varepsilon\right] = \left[\frac{1}{4n} + \frac{j-1}{n}, \frac{3}{4n} + \frac{j-1}{n}\right], \left[\frac{4j-3}{4n}, \frac{4j-1}{4n}\right] j = 1, 2, \dots, n$.

III. We divide the segment of the air defense from its beginning (that is, from the common point of HE and air defense) to some point at the top of the air defense (say, one or two centimeters 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 upper division). The procedure for choosing a scale on the LHO and plotting divisions on

it is determined by the value (see item I). For this purpose, we calculate the following values: x_1

$$l = 10^{-[\lg x_1] - 2},$$

$$t = \{-\lg x_1\}, q = \begin{cases} 10l & \text{for } t < \lg 2 \\ 5l & \text{for } \lg 2 \leq t < \lg 5 \\ 2l & \text{for } t \geq \lg 5 \end{cases}$$

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

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

2) We put five divisions on the LWO opposite to the divisions 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. $3 \leq x_1 \leq 5$.

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

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

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

IV. We build the columns of the Pareto chart. Taking into account the conclusion obtained in Section II, it remains only to determine their heights. Each of the defects has its own column, namely, the i th defect corresponds to the column with a number (see item I; we emphasize that the columns of the Pareto chart are always arranged in the order of non-increasing their heights). For each let us agree to call the unit of height the length of the segment [10%, 20%] of the air defense. From the content of clause III it follows that regardless of the value of the t th column of the Pareto chart will be such units. This column must be labeled with the name of the defect with a number, $n\eta_j, j = 1, 2, \dots, n, 1 \leq j \leq n\theta_{\eta_j} = j \cdot x_1 x_k / q \theta_k k = 1, 2, \dots, n$.

V. Having calculated the accumulated number of defects and the proportional values, we plot points with coordinates on the diagram (they lie on the vertical symmetry axes of the diagram's columns. The ordinates of these points are expressed in units of height). Connecting successively, we get a broken line (in this case, it is desirable to depict the points with circles of small radius). In addition, we connect the vertical axes with a horizontal line segment at the 80% mark on the air defense. The broken line and the segment should be depicted in different colors, for example, brown and yellow, respectively. We put (turns out to be a non-negative integer, less than) Introducing another notation, we set a number that

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always satisfies the inequalities. Color the first columns of the Pareto diagram in the third (for example, green) color, and the rest of its columns in the fourth (say, red) color. The share of defects $S_k = \sum_{j=1}^k x_j y_k = \frac{10S_k}{S_n}$, $A_k \left(\frac{2k-1}{2n}, y_k \right)$, $k = 1, 2, \dots, n$, $A_k A_k m = \sum_{k=1}^n \text{sign}(1 + \text{sign}(8 - y_k)) mn$. $y_0 = 0$, $r = (2m + 1 + \text{sign}(16 - (2S_n)^{-1} - y_m - y_{m+1}))/2$, $1 \leq r \leq n$.

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

a) This algorithm uses formulas containing the values of the function, which greatly simplifies the calculation procedure. $\text{sign}x$,

b) In all possible cases, the air defense contains only divisions 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, i.e. there are no divisions going beyond the limits of the range 0% 100% (and after all, the presence of such excessive divisions makes no sense for a Pareto chart). ÷

c) The choice of the scale on the BOP meets the following highly desirable requirements: c1) the largest of the columns of the Pareto chart does not exceed the 100% mark on the BOP; c2) opposite this mark on the LHO there is a mark corresponding to the smallest possible (subject to 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 LWO.

Thus, the software guarantees the researcher to obtain objective results for making informed decisions. Proof of the eligibility of using the program is confirmed by the research carried out on the analysis of the results of the activities of LLC Plant "Techmash" to identify the causes of defects in manufactured products for 2020-2021, and to develop measures to significantly reduce them. In the production process of any product, it is impossible to obtain all products of the same quality, that is, the parameters of various units of products fluctuate within certain limits. This fluctuation is caused by a complex of random and systematic reasons that operate in the production process and determine the errors of this technological process. If the fluctuation of parameters is within acceptable limits (within tolerance),

The quality of the manufactured products at the enterprise LLC Plant "Techmash" is determined by the quality of the initial products, the degree of equipment tuning, compliance with the technological regimes. In order to timely identify defects and the causes that caused it, it is necessary to carry out systematic control of product parameters, to receive and process data on controlled parameters. Using the methods of analyzing the causes of defects and defects in manufactured products and developing measures to prevent them, it is possible to find a solution to the

occurrence of problems in the production process, for example, the cause of the appearance of defects.

Defect - each individual non-conformity of products with the requirements established by the regulatory documentation.

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

Providing free approaches to the controlled parts at the design stage eliminates the need to modify the design of products for testing.

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

The designer must indicate the methods and means of NDT, including the devices for built-in flaw detection of objects, the ability to control which must be provided in the planned volume. If it is not possible to use known methods and controls, new ones should be developed and recommended.

The designer must develop technical documentation for flaw detection, including a list of controlled objects and schemes for placing them on the product, recommended methods, means and technology of control, criteria for rejection, the sequence of testing, the procedure for introducing control under the operating conditions of the product and the subsequent expansion of its volume. In addition, the duration and necessary labor costs for preparation and execution of control operations should be determined.

Work to ensure the manufacturability of products and the creation of technical documentation for flaw detection is carried out by the designer together with specialists in flaw detection, production and operation of machines - objects of control. Due to mistakes made at the design stage by the designer, defects arise in products.

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

Consider metallurgical defects that are formed during the smelting of ingots or casting parts. The most common metallurgical defects are: shrinkage and gas pockets, cracks and inclusions.

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

Gas cavities are rounded cavities with a diameter of 1 ... 3 mm and more with a smooth shiny surface. The main reasons for the occurrence may be: low gas permeability of the mold and rods; poor handling of refrigerators, etc.

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Cracks - These are discontinuities in the form of metal breaks. The formation of cracks in a continuous ingot is associated with stresses arising in the process of its formation, and is due to the reduced strength and plasticity of the metal in different temperature ranges.

Inclusions are of two kinds and origin: the inclusion of non-metallic particles trapped in the metal from the outside (slag, refractory, sand, graphite) and metallic inclusions (ferroalloys, sunken pieces of bars or marking bows, etc.)

Formation of defects in the products of LLC Plant "Techmash" may arise due to a number of reasons related to the control of the process. The main factor affecting the omission of defects is the qualification, certification and training of personnel, as well as the conscientious performance of the NDT operator's work.

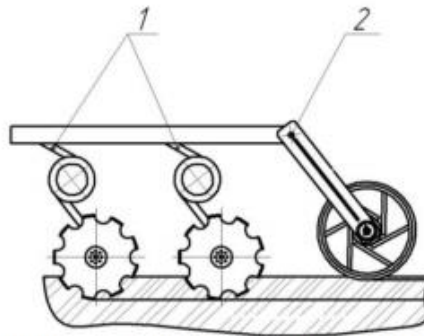
The most common type of defects is cracks in die-forged parts. A crack is a clear (transparent)

discontinuity that runs along or through grain boundaries. Typically, cracks are caused by local overstressing of the metal during stamping or other shaping operations, or as a result of heat treatment. It is customary to subdivide cracks of such a group into longitudinal, shearing, internal and transverse cracks.

Let us consider the example of a Hoe a rotary harrow BMR, which has the largest number of defects.

The unit is designed for continuous and inter-row processing of any crops, cereals, 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 for combating weeds, incorporating crop residues into the soil.

The most common defect in this harrow is disc wedging (Figure 21).



1 – дисковые рабочие органы на индивидуальных спиральных стойках; 2 – каток

Figure 21 - Schematic representation of an ICBM in profile

Jamming of the rotating disc occurs due to the failure of the bearing assembly. This is due to the fact that low-quality bearings are used for the manufacture of a disk working body. The way out of this situation can be the purchase of higher quality bearings.

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

A defect on the surface of metal and metal products, accompanying during their heat treatment, is the formation of a decarburized layer due to the burnout of part of the carbon when the metal is heated for subsequent quenching. Decarburization of the metal surface can take place both at the stages of rolling, preparation of metal for upsetting, and during heat treatment to the appropriate strength class of finished parts. Decarburization and scale formation significantly reduces the mechanical properties in the surface layers of the metal, the surface becomes susceptible to the formation of scratches, scoring, scratches during rolling, calibration, upsetting, and thread breakage is possible during mechanical tests.

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, product warpage and distortion of the geometric dimensions of the thread are possible. It is possible to exclude such a defect only by using isothermal quenching in more viscous quenching media.

Quenching cracks in a deformed metal can appear during quenching as a result of the occurrence of high stresses of structural transformation and temperature stresses. Quench cracks usually have an irregular wandering path on the surface of the fastener. The main reasons for the appearance of temperature stresses are: rapid heating for quenching, rapid cooling in the region of martensitic transformation, a complex configuration of a product with abrupt transitions, and a significant time gap between quenching and tempering operations.

Defect control at OOO Plant Tekhmash. It is carried out by a special commission and employees

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authorized by the head of the quality control department or higher managers.

Input (preliminary) control 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 marriage (poor quality of objects and tools, etc.) and thereby prevent it. This includes inspection of materials, workpieces or parts prior to processing or assembly, inspection of fixtures and measuring instruments, and inspection of setup. During the setup control, the first copies of the parts processed after the equipment setup are checked. Based on the results of this check, a decision is made whether to continue working or whether it is necessary to readjust the equipment.

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

During acceptance (final) control, finished workpieces, parts, assembly units of the machine are checked after the last (final) operation in this workshop, before delivery to the warehouse, or before transferring them to the next workshop, or before shipment to the consumer. Its purpose is to prevent the transfer of substandard products to the consumer.

Active control is understood as control in which quality is checked during the technological process, and the results of the control are used for the current regulation of the process. This includes monitoring the quality indicators of objects and regulating 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 foundations of the organization of which are discussed in the next paragraph.

Passive control includes all types of control in which quality is detected only after the end of the technological process, and operational intervention in the process is carried out after the discovery of the unsuitability of the product. This should also include checking parts with the help of technical devices that determine the actual level of their quality after manufacturing (control and sorting machines for balls and rollers for bearings, pistons, piston rings, pins and other cylindrical parts).

The number of detected defects in the forging for 2020 is shown in Table 6 and in Figure 28, the constructed Pareto chart for the identified defects for 2020, the expected number of defects in 2021 is given in Table 7, and the constructed Pareto chart in Figure 22

Table 24. -Characteristics of product defects at Tekhmash Plant LLC for 2020

The name of the defects revealed in the sold machines	The number of detected defects in the sold machines	Accumulated share of detected defects	Total number of detected defects (cumulative percentage)
Bearing failure	17	38%	38%
Jammed rotation discs	9	20%	58%
Violation of the part hardening technology	5	11%	69%
Frame deformation	4	9%	78%
Crack Disc	3	6%	84%
Other	7	16%	100%
Total	45	100 %	

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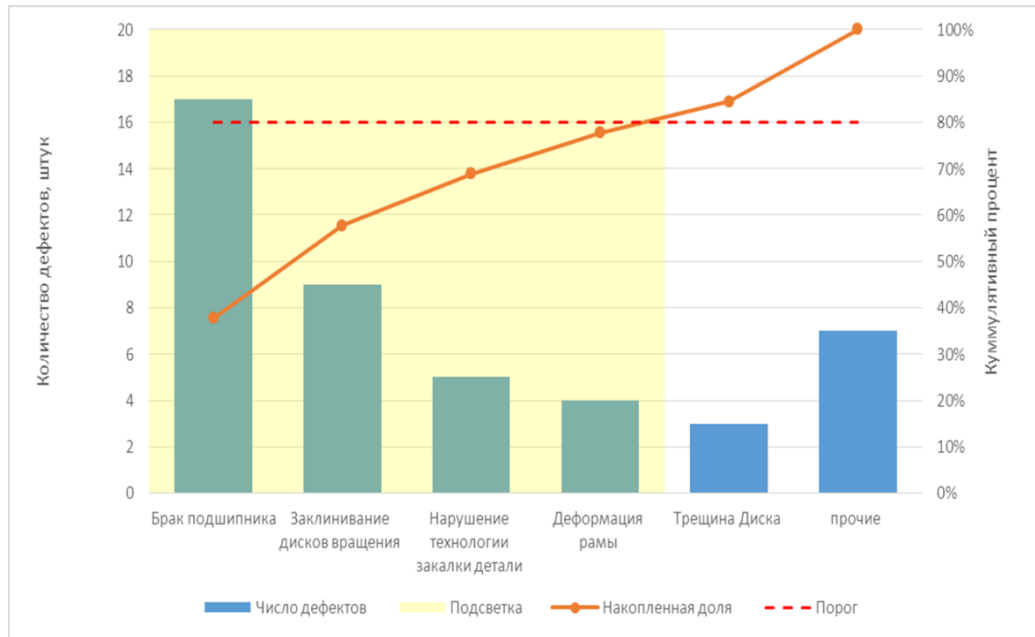


Figure 22 - Pareto chart and cumulative curve characterizing product defects identified in 2020 at LLC Plant "Techmash"

Table 25 Characteristics of product defects at Tekhmash Plant LLC for 2021 (expected)

The name of the defects revealed in the sold machines	The number of detected defects in the sold machines	Accumulated share of detected defects	Total number of detected defects
Jammed rotation discs	4	38%	38%
Violation of the part hardening technology	3	twenty%	58%
Frame deformation	2	eleven%	69%
Wheel axle deformation	2	6%	84%
Crack Disc	1		
Other	1	16%	100%
Total	13	100 %	

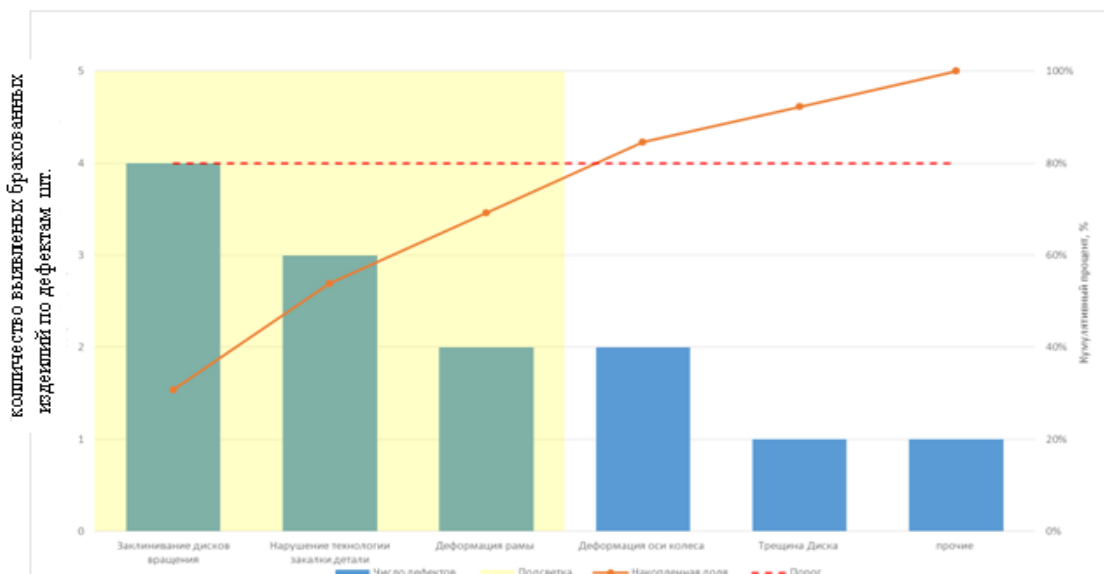


Figure 23 -Pareto chart and cumulative curve characterizing product defects identified in 2021 (expected) at LLC Plant "Techmash"

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Measures to reduce the production of defective products at LLC Plant "Tekhmash". The main tasks of the control service of LLC Plant "Techmash" are: systematically, timely and efficiently control the quality of incoming materials and products, technological (installation) work, the quality of manufactured products, the technical condition of products during operation using the necessary methods and means of control in accordance with the requirement valid documentation; to prevent the transfer of defective products for subsequent technological operations or handing over to the customer; to contribute to the improvement of the quality of design, technological, installation, repair and other works; make acceptance of the performed operations and work with the registration of the necessary technical documentation and participate in the delivery of materials and products to the customer;

Control and diagnostic operations should be considered as the most important technological redistribution, ensuring quality, with all the following conclusions. The effectiveness of the final result - long-term performance of objects at minimal cost - largely depends on the correct choice of NDT. As an example, we can cite the method of testing large-diameter pipes using hydraulic presses, which is still used today, for which it is necessary to build special workshops and multi-ton test equipment. At the same time, an automated ultrasonic flaw detector allows detecting defects with greater reliability than hydrotesting, while the cost of testing is reduced by hundreds of times. Test algorithms should be formed by diagnostic technology in order to determine what and how should be applied.

It can be argued that there is not a single infallible control method. Unforeseen operating conditions may occur, therefore, diagnostic technologies should be "redundant" in relation to the use of a set of NDT methods and techniques that are different in physical essence, which would complement each other to ensure maximum product quality assurance.

The technology should provide for 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 facilities. It should have a library of algorithms and diagnostic programs executed in relation to specific products, operations and tasks of detecting defects.

The most important point - making a decision on the non-compliance of the product with the requirements and the termination of its operation or functioning - should be specially noted and

scientifically substantiated in technology. The foundation of this decision is pre-assembled statistical material.

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

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

The quality of the manufactured products at the enterprise LLC Plant "Techmash" is determined by the quality of the initial products, the degree of equipment tuning, compliance with the technological regimes. In order to timely identify defects and the causes that caused it, it is necessary to carry out systematic control of product parameters, to receive and process data on controlled parameters. Using the methods of analyzing the causes of defects and defects in manufactured products and developing measures to prevent them, it is possible to find a solution to the occurrence of problems in the production process, for example, the cause of the appearance of defects.

Conclusion

The quality is "written by nature" to be at all times in the epicenter of scientific and amateurish reflections. The problem of ensuring the quality of activities is not just universal, relevant, it is strategic.

Today, and even more so tomorrow, it is important to implement one of the defining principle of production efficiency - the manufacturer produces exactly what is needed not only for domestic, but also for foreign consumers, and solving the problem of increasing the efficiency and competitiveness of the economy, and ultimately the quality of life, is impossible without implementation of a well-thought-out and competent industrial policy, in which innovations based on digital production and quality should become the priority areas of the state's economic policy (figure).

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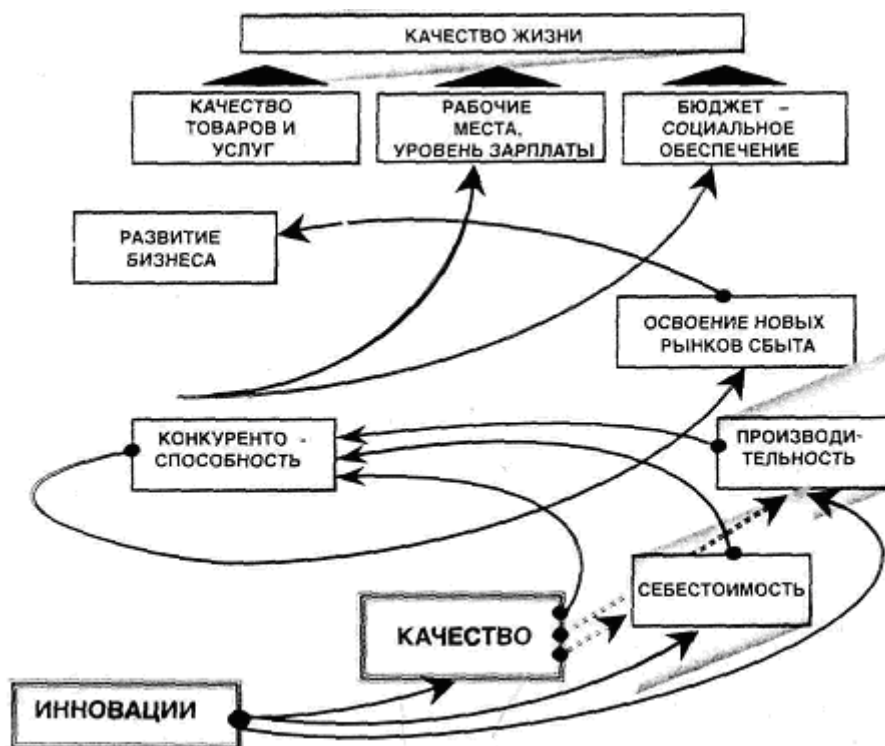


Figure 24 Innovation and quality - the road to high living standards

The problems of improving the quality and competitiveness of materials and products at the present stage of development of the Russian economy are becoming increasingly important. As the experience of advanced countries that at one time emerged from such crises (the United States in the 30s, Japan, Germany in the post-war period, and later South Korea and some other countries) shows, in all cases, the basis for industrial policy and recovery economy, a strategy was put in place to improve the quality, competitiveness of products, which would be able to conquer both domestic and foreign sales markets. All the other components of the reform - economic, financial, credit, administrative - were subordinated to this main goal.

The developed software for the formation of the technological process for the production of import-substituted products and the determination of specific reduced costs, which are the sum of current costs (prime cost) and capital investments, commensurate with the standard efficiency factor, taking into account the production program, makes it possible to calculate the static parameters of the technological process of production of import-substituted products when various forms of organization of production. The developed software for calculating cash flows from the operating activities of light industry enterprises based on assessing the degree of implementation and dynamics of production and sales of products, determining the influence of factors on the change in the value of these indicators, identifying on-farm reserves and developing measures for their

development, which are aimed at accelerating turnover production and reduction of losses, which guarantees the enterprises of light industry to obtain stable TPE and prevents them from bankruptcy.

Based on the current situation in the economy of our country, in our opinion, no less significant problem in the development of the regional consumer market is the lack of a full-fledged regulatory framework that ensures the functioning of the mechanism of state regulation of the consumer market in the regions. Proceeding from this, it is the state and regional intervention that should correct the situation on the market of domestic products of light industry enterprises in the regions, and thus there will be an opportunity for the development of production of competitive and import-substituting products.

The implementation of the planned measures will lead to covering the deficit for all types of products, will ensure an increase in labor mobility in the Southern Federal District and the North Caucasus Federal District and a reduction in negative processes in the labor market, as well as a stable balance of interests of consumers, employers and municipal, regional and federal branches of government. For the successful implementation of all of the above measures, the interest of the regional authorities in the development of production of competitive and import-substituting products, reduction in prices for components and energy costs and benefits for the transportation of products produced by enterprises in the regions of the Southern Federal District and the North Caucasus Federal District is most necessary.

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Therefore, only a stake on innovation, quality, and competitiveness of products and services should be the basis of the industrial policy pursued at all levels yesterday, today and, moreover, tomorrow.

Other economic effect of work results is limiting, which consists in increasing labor productivity, the level of mechanization of production, lowering the indicators of work in progress and the cost of digital production. An accessible tool for digital production technologists is proposed to rationalize the design of technological processes, which allows an enterprise to form a competitive assortment and predict the maximum income from the production of import-substituting products.

An assortment policy has been developed for the formation of competitive products, taking into account factors affecting consumer demand: compliance with the main fashion trends, taking into account the economic, social and climatic characteristics of the regions of the Southern Federal District and the North Caucasus Federal District, the production of which using modern innovative technological processes, as well as to meet the demand of an elite consumer, with the use of manual labor create the basis for satisfying the demand for footwear for buyers in these regions.

Innovative technological processes have been developed for the production of import-substituting products using modern technological equipment with advanced nanotechnologies, which form the basis for reducing the costs of import-substituting products and ensuring their competitiveness with the products of leading foreign companies, with the possibility of a wide-range production of products not only by type, but also by sex and age groups, which guarantees her demand in full.

The layouts of technological equipment are proposed, on the basis of which it is possible to form a technological process for the production of import-substituting products with an optimal volume of output, taking into account the production area and the form of organization of digital production.

Software has been developed for calculating cash flows from the operating activities of light industry enterprises based on assessing the degree of implementation and dynamics of production and sales of products, determining the influence of factors on the change in the value of these indicators, identifying

on-farm reserves and developing measures for their development, which are aimed at accelerating turnover production and reduction of losses, which guarantees enterprises to obtain stable TEP and prevents them from bankruptcy.

Software has been developed for the formation of the technological process of digital production and the determination of the cost of production of import-substituting products. A computer simulation model has been implemented that describes the dynamics of the process of manufacturing import-substituting products. The proposed methodology and software implemented on this basis can reduce the duration of technological preparation of production and increase, due to the rationalization of the technological process, the specific consumer effect of import-substituted products.

The proposed technique makes it possible to reduce the duration of technological preparation of digital production and reduce the time of expert work while maintaining the required depth and validity of engineering conclusions. The economic effect of the research is expressed in the intellectualization of the technologist's labor with a reduction in time spent on developing the range of manufactured import-substituting products and assessing the efficiency of technological processes in comparison with a typical economic calculation of the total cost of manufacturing such products.

The analysis of the influence of the forms of organization of digital production and manufacturing technology on the cost of import-substituting products is carried out using the example of the technological process of manufacturing popular products, taking into account the shift program. Theoretical dependencies have been obtained to assess the influence of the factor "organization of production" on individual calculation items as a whole and other technical and economic indicators in order to prevent enterprises from bankruptcy.

Thus, all this in aggregate will provide enterprises in the regions of the Southern Federal District and the North Caucasus Federal District with a stable position both in the domestic and in the markets of the near and far abroad. All that is needed is the goodwill and interest of all participants in this process.

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