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ON NEW POSSIBILITIES OF STATISTICAL QUALITY CONTROL METHODS FOR MANAGING DIGITAL PRODUCTION OF IMPORT-SUBSTITUTING PRODUCTS FOR CONSUMERS IN THE REGIONS OF THE SOUTHERN FEDERAL DISTRICT AND THE NORTH CAUCASUS FEDERAL DISTRICT

Abstract: *in the authors analyzed the possibilities of the enterprise's policy and goals in the field of quality within the framework of the QMS in order to fight for defect-free production, for reducing rejects and guaranteeing consumers a high quality of manufactured products. The use of software to assess the validity of the choice of innovative technological solutions for the production of import-substituting products by domestic enterprises creates the preconditions for its demand and competitiveness not only in the domestic market, but, which is especially important, in its export. The need to improve the quality management system at domestic enterprises is due to the following important reasons. Firstly, this is an increase in the confidence of potential consumers in the products that will be produced by domestic enterprises. Secondly, this is an opportunity to significantly strengthen its position in existing markets, as well as significantly expand the spheres of influence by entering new domestic and foreign markets. And thirdly, this is a significant increase in labor productivity of any industrial enterprise, which is supposed to introduce QMS with the use of participatory management.*

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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The need to tighten responsibility for the quality of import-substituting products is confirmed by the results of checking this very quality by specialists from Roskachestvo. In their opinion, the quality of products does not depend on their price, it is only necessary to strictly comply with the requirements of

GOSTs and technical regulations during their production, increasing the level of responsibility of enterprise managers for the results of their work and the level of individual responsibility of performers employed in workplaces in the digital production of import-substituting products.

The experience of applying statistical methods of quality control using the Pareto diagram at machine-building enterprises in the regions of the Southern Federal District and the North Caucasus Federal District are presented below in the form of research results

The modern market economy makes fundamentally new requirements for the quality of products. Quality management is one of the key functions of both corporate and project management, the main means of achieving and maintaining the competitiveness of any enterprise. The key task of the management of companies is the creation, practical implementation and subsequent certification of the quality management system (a modern term that replaced the previously used term - "quality management systems"), and the products supplied for a certain period of time (contract validity, release date for this type of product, etc. etc.). Quality management is, in essence, a cross-cutting aspect of the enterprise management system - similar to such as time, costs, personnel management.

Quality is formed in the production process, therefore, the main factor in ensuring quality and one of the decisive elements of ensuring the competitiveness of an enterprise is the quality management system operating at the enterprise.

The reason for the development of the QMS is the awareness of the new realities of the market. Now the presence of a certified QMS is practically becoming a necessity: this is a mandatory requirement of some customers when concluding contracts, this is a mandatory requirement for participation in most tenders. Voluntary certification of the QMS is gradually becoming a necessity for manufacturers, in fact, becoming mandatory. That is why QMS is one of the stages in the development of every modern enterprise. When developing a QMS, it is necessary to coordinate management activities in relation to quality, thereby strengthening the relationship of all structural divisions.

The quality of products, their technical level is assessed by comparing the technical and economic indicators of products with the best domestic and foreign samples, as well as with products of competing organizations. In this case, the assessment is carried out according to the main indicators characterizing the most important properties of the products.

The manufacture of rejected products leads to a decrease in the amount for manufactured and sold products, to an increase in the cost of production, to a decrease in profits and profitability.

In the process of analysis, the dynamics of marriage is studied in terms of the absolute amount and share in the total output of marketable products; losses from marriage are determined. Then the reasons for the decrease in the quality and admitted defects of products are studied in the places of their occurrence and in the centers of responsibility, and measures are developed to eliminate 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 the parameters is within the permissible limits (within the tolerance), then the product is suitable, but if it goes beyond these limits - the rejects, which are either disposed of or restored and re-sold.

In modern conditions of aggravation of competition, its transformation into a global basis for the survival and success of an enterprise, the basis of a stable position of an enterprise in the market is a timely offer of products that meet the world level of quality. At the same time, the competitiveness of any enterprise, regardless of size, form of ownership and other features, depends primarily on the quality of the product and the commensurability of its price with the offered quality, i.e. on the extent to which the company's products meet the needs of the consumer.

These circumstances lead to a natural growth of the role of the quality management system of the enterprise as a universal tool for increasing the competitiveness of the enterprise, which allows to achieve the goal of reducing the cost of manufactured products with absolute satisfaction of consumer requirements.

The most widespread in the world organizational and methodological basis for creating a quality management system for enterprises is the international standards ISO 9000 series. Creation of a quality system based on these standards allows an enterprise to move from product quality management to quality management of the entire enterprise.

Within the framework of the quality system, the economic aspect is also implemented - taking into account the relationship between product quality and the results of the economic activity of an enterprise through taking into account its costs for quality assurance and comparing them with losses associated with the release of low-quality products.

The crisis state of the domestic economy determines the exceptional urgency of creating a quality management system at Russian enterprises in order to ensure the competitiveness of enterprises. For the majority of enterprises in our country, a situation is typical when the non-competitiveness of products in terms of quality is aggravated by non-

competitiveness in terms of price due to the excessive cost of production. Therefore, one of the prerequisites for bringing the Russian economy out of the crisis is the introduction of effective quality management systems capable of ensuring the competitiveness of the manufactured product in terms of price and quality.

Thus, in order to increase the competitiveness of enterprises, the problem of creating quality systems should be solved both at the level of individual enterprises and at the state level. Among the measures designed to stimulate enterprises to introduce quality management systems, the establishment in 1996 of the annual Prize of the Government of the Russian Federation in the field of quality, as well as the adoption by the Government in 1998 of a resolution "On some measures aimed at improving systems for ensuring the quality of products and services" ...

However, the task of creating an efficiently functioning quality management system should be solved, first of all, at the level of a particular enterprise, taking into account its characteristics determined by the field of activity, the current financial condition, the existing level of implementation of consistency in work on quality assurance, etc.

Currently, the number of enterprises implementing a quality management system based on the ISO 9000 series has increased dramatically, which is facilitated by a number of circumstances, the main of which are:

organization of work on the implementation of quality systems is an important element of several federal programs;⁎

when creating joint ventures, foreign firms and companies often set a prerequisite: preparation and operation of a quality system in accordance with the ISO 9000 series standards;⁎

⁎ enterprises of various industries seeking to export products are faced with the problem of introducing ISO standards and certification of quality systems for compliance with these standards during contract negotiations, and also in a number of countries it becomes difficult to sell products without confirming the stability of quality during their release;

creation of more favorable conditions for insurance, obtaining a loan, investment, participation in tenders, competitions and other events that may end with a contract; ⁎

the executive discipline at the enterprise is increased, the motivation of employees is improved, the losses that were provoked by defects and inconsistencies are reduced;⁎

the enterprise becomes more "transparent" for management, in this regard, the quality of management decisions increases;⁎

A number of problems that the company faces on the way to create a quality management system, namely:

⁎the specialists of our enterprises have no real experience of work in the conditions of market relations. During the certification of quality systems, the lack of such experience is observed in many forms, namely: in the inability to establish effective feedback with consumers; lack of skills in the assessment and selection of suppliers; in an unclear distribution of responsibility between managers of different levels; in duplication of some processes, etc .;

⁎Taking managerial decisions on the implementation of quality assurance activities, the heads of enterprises pursue the goal of not creating an efficiently functioning quality system, which will actually guarantee the quality of products in accordance with the needs and expectations of consumers, namely, obtaining a certificate, certificate. The external market for domestic enterprises that do not have a quality system based on the ISO 9000 series is practically closed. Therefore, the administration of enterprises is primarily interested in the timing of obtaining an international certificate of quality. And issues related to the volume of labor, material, technical and financial resources required for the implementation and certification of the quality system and, most importantly, to ensure its cost-effective operation, fade into the background;

⁎the appointment of specialists for the development and implementation of quality management systems according to the international quality management system by the management of an enterprise is often carried out without proper selection of candidates and understanding of the criteria that these candidates must satisfy.

Despite the many reasons that make the work of introducing an international system based on the international standards ISO 9000 series in domestic enterprises by no means easy, many enterprises have quite consciously embarked on this path. In the process of purposeful work on improving their quality management systems, they have made tangible changes for the better, strengthened their position among competitors and now set themselves more challenging goals. Increasing the competitiveness of an enterprise through the implementation and improvement of the quality management system is a problem that requires an integrated approach, covering not only the production process of products, but also its implementation and after-sales service.

In September 2015, the international standard ISO 9001: 2015 came into force. Russian version of GOST R ISO 9001-2015 “Quality management systems. Requirements "entered into force on November 01, 2015.

In the new version of the GOST R ISO 9001-2015 standard, relative to the previous one,significant changesin particular, the structure of the standard has changed. The new version of the standard now contains 10 sections instead of 9.

The updated version of GOST R ISO 9001-2015 includes the following sections:

0. Introduction.

This section of the GOST R ISO 9001-2015 standard provides general provisions on the quality management system, quality management principles and the process approach.

1 area of use.

This section establishes the scope of the GOST R ISO 9001-2015 standard. As in the previous version of the GOST ISO 9001-2011 standard, the section establishes uniform requirements for quality management systems of an enterprise, regardless of size and areas of activity. The GOST R ISO 9001-2015 standard can be applied:

⁕ when an enterprise wants to demonstrate the ability to manufacture products or provide services that meet customer requirements;

⁕ for the purpose of increasing customer satisfaction.

2. Normative references.

This section of the GOST R ISO 9001-2015 standard provides links to interrelated standards.

3. Terms and definitions.

The terms and definitions used in GOST R ISO 9001-2015 are given in the new version of GOST R ISO 9000-2015.

4. The environment of the enterprise.

This section of GOST R ISO 9001-2015 establishes requirements for:

identification of internal and external conditions of the enterprise, affecting the quality management system and the results of the enterprise;⁕

⁕ identification of interested parties influencing the QMS and determining the requirements of interested parties, monitoring these requirements;

⁕ defining the scope of the quality management system, which should be documented;

⁕to the definition and management of QMS processes. Opportunities and risks should also be identified for each QMS process.

5. Leadership.

This section of GOST R ISO 9001-2015 establishes requirements for:

⁕ top management, which should take a leading role in the implementation and management of the QMS;

⁕ quality policy;

⁕ top management, which must define responsibility, authority and assign roles at the enterprise for the functioning of the QMS and the implementation of customer requirements.

6. Planning.

This section of GOST R ISO 9001-2015 establishes requirements for:

⁕identification of risks and opportunities that can affect the QMS and the achievement of the enterprise's planned results. Requirements are established for developing a response plan for risks and opportunities;

⁕ defining quality objectives and planning the achievement of quality objectives;

⁕ planning changes to the QMS.

7. Provision

This section of GOST R ISO 9001-2015 establishes requirements for:

⁕ management of resources, infrastructure, personnel, knowledge, production environment, as well as tools for monitoring and measuring;

⁕ requirements for the competence of personnel;

⁕ awareness of personnel on QMS issues;

⁕ the definition of external and internal interactions affecting the QMS of the enterprise;

⁕ documentation (creation, updating, management of documented information).

8. Processes.

This section of GOST R ISO 9001-2015 establishes requirements for:

⁕ planning and management of QMS processes;

⁕ defining requirements for products and services;

⁕ development and design of products and services;

⁕ management of external support for products and services;

⁕ preservation of products and services;

⁕ production of products and services;

⁕ management of nonconforming products, services, processes.

9. Conducting an assessment.

This section of GOST R ISO 9001-2015 establishes requirements for:

⁕monitoring, measurements, analysis and assessment of the QMS and the activities of the enterprise. Also specifies requirements for measuring customer satisfaction;

⁕ to conduct internal audits of the QMS;

⁕ conducting an analysis of the enterprise's QMS by the top management.

10. Improvements

This section of GOST R ISO 9001-2015 establishes requirements for:

⁕ making improvements in products, services and processes, as well as the company's QMS.

⁕ actions upon detection of non-conformities, taking corrective actions;

⁕ continuous improvement of the QMS and the results of the enterprise.

The new structure of the standard is reflected in the schematic representation of the process approach. The process approach diagram reflects the relationship of all clauses of the standard, as shown in Figure 1.

The key changes in the new version of the standard are the requirements for risk assessment, as

well as a risk management approach in the design and development of a quality management system.

Figure 1 - Scheme of the process approach

The International Accreditation Forum (IAF) has approved a three-year transition period from mandatory ISO 9001: 2008 (GOST R ISO 9001-2011) to ISO 9001: 2015 (GOST R ISO 9001-2015). During this period, both standards and certificates of conformity issued to the enterprise by certification bodies will be in force. Certificates issued for compliance with ISO 9001: 2008 ceased to be valid only in September 2018.

Among the statistical methods of quality control, the most common both today and tomorrow, the so-called seven quality control tools:

- Pareto chart;
- Ishikawa's causal diagram;
- control card;
- bar graph;
- scatter chart;
- stratification method;
- checklists.

Taken together, these methods form an effective system of methods for quality control and analysis. Seven simple methods can be applied in any sequence, in any combination, in various analytical situations, they can be considered both as an integral system and as separate analysis tools. In each specific case, it is proposed to determine the composition and structure of the working set of methods.

The Pareto chart allows you to visualize the amount of defect loss depending on various objects; it is a kind of a bar chart used to visualize the factors under consideration in order of decreasing significance.

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 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 many Pareto charts. 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 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 an undesirable factor can be eliminated with a simple solution, this must be done immediately, no matter how insignificant it may be... Since the Pareto chart is regarded as an effective tool for 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 gained experience, information and moral satisfaction can have a beneficial effect on the further procedure for solving problems; Opportunities to draw up a Pareto chart should not be missed for reasons.

In a rectangular coordinate system, equal segments corresponding to the factors under consideration are laid along the abscissa, and the value of their contribution to the problem being solved along the ordinate. 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 the product sales data shown in the table figure 2:

	A	B
1	**Товар**	**Прибыль, млн. руб.**
2	Хлеб	962
3	Крупа	115
4	Овощи	190
5	Фрукты	226
6	Сахар	132
7	Мясо	537
8	Рыба	764
9	Молоко	157
10	Яйца	278
11	Масло	96

Figure .2 - Product sales data

The data in the table (Figure 2) is not ordered, so first of all we will sort the data in descending order of profit. To do this, select the table (Figure 3) and select Data -> Sort and Filter -> Sort in the tab bar:

Additionally, we added several columns to the table (Figure 3) (Figure 4):

Increasing percentage of profit,%- 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);

Backlight criterion - in the final diagram, the main sources of profit will be highlighted, we indicate a value obviously greater than 1.

To build a Pareto chart, the initial data are presented in the form of a table, in the first column of which the analyzed factors are indicated, in the second - absolute data characterizing the number of cases of detection of the analyzed factors in the period under consideration, in the third - the total number of factors by type, in the fourth - their percentage , in the fifth - the cumulative (accumulated) percentage of cases of detection of factors.

"Other factors" are always placed last on the ordinate; if the share of these factors is relatively large, then it is necessary to decipher them, highlighting the most significant ones. Based on these, the initial data, a bar chart is built (Figure 5), and then, using the data in column 5 and an additional ordinate denoting the cumulative percentage, a Lorentz curve is drawn. It is possible to build a Pareto diagram when the data of columns 4 are laid on the main ordinate; in this case, to plot the Lorentz curve, there is no need to include an additional ordinate in the diagram.

	A	B	C	D	E
1	**Товар**	**Прибыль, млн. руб.**	**Нарастающий процент прибыли, %**	**Коэффициент**	**Подсветка**
2	Хлеб	962	27,8%	80%	200%
3	Рыба	764	49,9%	80%	200%
4	Мясо	537	65,5%	80%	200%
5	Яйца	278	73,5%	80%	200%
6	Фрукты	226	80,0%	80%	0%
7	Овощи	190	85,5%	80%	0%
8	Молоко	157	90,1%	80%	0%
9	Сахар	132	93,9%	80%	0%
10	Крупа	115	97,2%	80%	0%
11	Масло	96	100,0%	80%	0%

Figure 3 - Product sales data with added columns

	A	B	C	D	E
1	Товар	Прибыль, млн. руб.	Нарастающий процент прибыли, %	Коэффициент	Подсветка
2	Хлеб	962	=СУММ($B$2:B2)/СУММ($B$2:$B$11)	0,8	=ЕСЛИ(C2<D2;2;0)
3	Рыба	764	=СУММ($B$2:B3)/СУММ($B$2:$B$11)	=D2	=ЕСЛИ(C3<D3;2;0)
4	Мясо	537	=СУММ($B$2:B4)/СУММ($B$2:$B$11)	=D3	=ЕСЛИ(C4<D4;2;0)
5	Яйца	278	=СУММ($B$2:B5)/СУММ($B$2:$B$11)	=D4	=ЕСЛИ(C5<D5;2;0)
6	Фрукты	226	=СУММ($B$2:B6)/СУММ($B$2:$B$11)	=D5	=ЕСЛИ(C6<D6;2;0)
7	Овощи	190	=СУММ($B$2:B7)/СУММ($B$2:$B$11)	=D6	=ЕСЛИ(C7<D7;2;0)
8	Молоко	157	=СУММ($B$2:B8)/СУММ($B$2:$B$11)	=D7	=ЕСЛИ(C8<D8;2;0)
9	Сахар	132	=СУММ($B$2:B9)/СУММ($B$2:$B$11)	=D8	=ЕСЛИ(C9<D9;2;0)
10	Крупа	115	=СУММ($B$2:B10)/СУММ($B$2:$B$11)	=D9	=ЕСЛИ(C10<D10;2;0)
11	Масло	96	=СУММ($B$2:B11)/СУММ($B$2:$B$11)	=D10	=ЕСЛИ(C11<D11;2;0)

Figure 4 - Deciphering the formulas of the auxiliary table (Figure 3)

To build a Pareto chart, the initial data are presented in the form of a table, in the first column of which the analyzed factors are indicated, in the second - absolute data characterizing the number of cases of detection of the analyzed factors in the period under consideration, in the third - the total number of factors by type, in the fourth - their percentage , in the fifth - the cumulative (accumulated) percentage of cases of detection of factors.

"Other factors" are always placed last on the ordinate; if the share of these factors is relatively large, then it is necessary to decipher them, highlighting the most significant ones. Based on these, the initial data, a bar chart is built (Figure 5), and then, using the data in column 5 and an additional ordinate denoting the cumulative percentage, a Lorentz curve is drawn. It is possible to build a Pareto diagram when the data of columns 4 are laid on the main ordinate; in this case, to plot the Lorentz curve, there is no need to include an additional ordinate in the diagram.

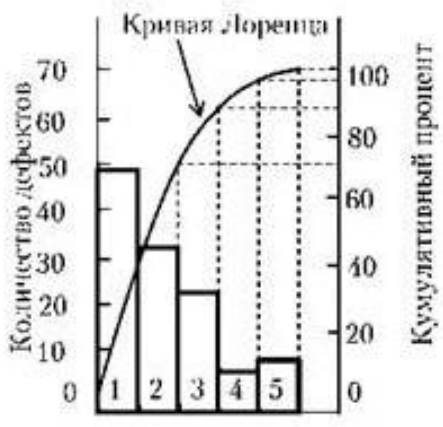

Figure 5 - Pareto chart

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, the Pareto chart is used (Figures 6 and 7).

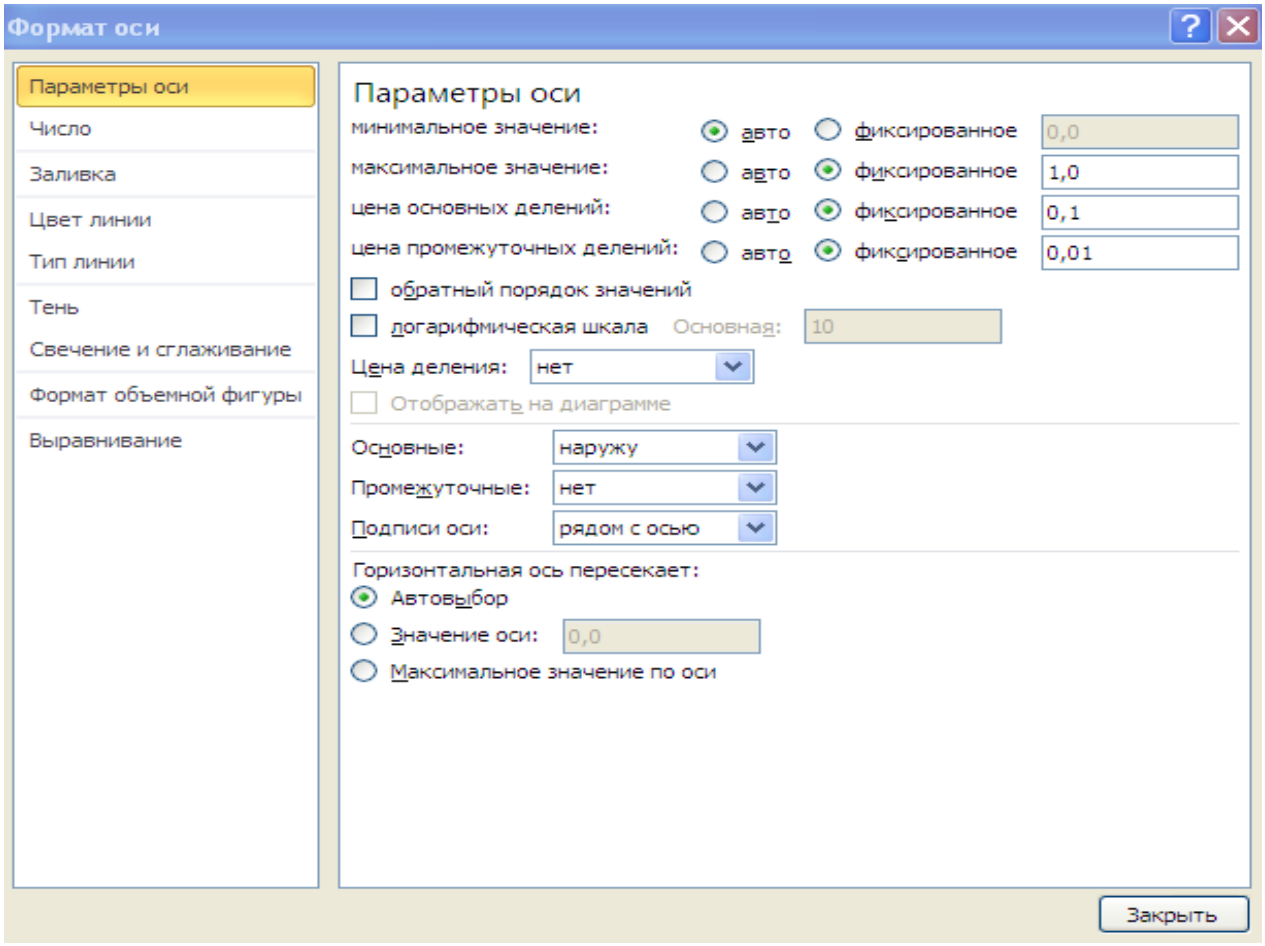

Figure 6 - Window for building a Pareto chart in Excel

Defect	Number of defects	Accumulated share of defects	Cumulative percentage
knotting	96	12	12%
span	94	13	25%
hood	85	eleven	36%
white	84	eleven	47%
massive cliff	72	nine	56%
"Sliding" warp threads	69	nine	65%
"Prickly" surface	58	7	72%
oil stains	56	eight	80%
knots	53	6	86%
overshoot	41	6	92%
edge flaking	39	5	97%
others	25	3	100%
total	772		

Figure 7. Initial data for building a Pareto chart in Excel

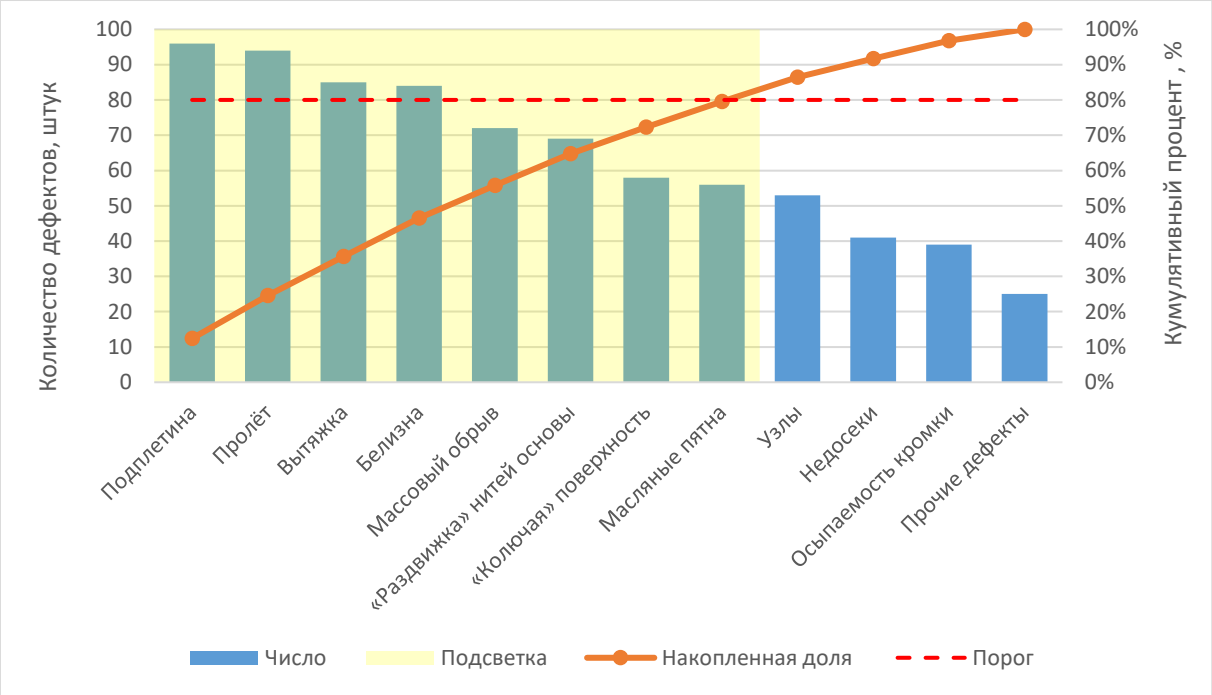

Figure 8 - An example of building a Pareto chart for identified defects Select all the data (Figure 2) and insert it into the histogram. To do this, go to the tab bar on Insert -> Chart -> Histogram -> Histogram with grouping (Figure 1.9):

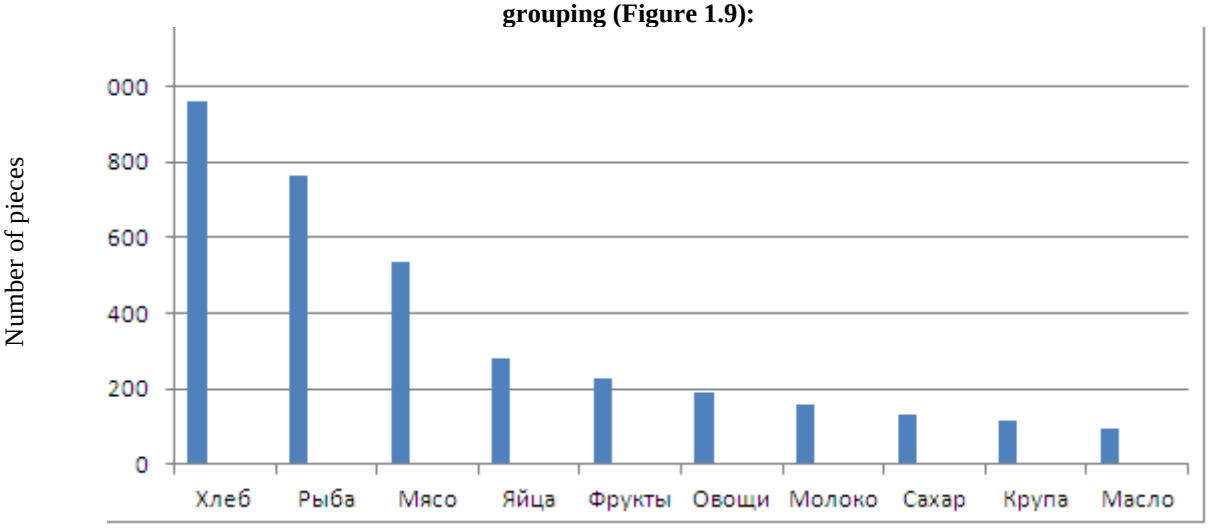

Figure 9 - Building a histogram

Now let's transform the graph into a more convenient form. Select the row "Increasing percentage of profit,%" and transfer it to the secondary axis (right-click on the row, select Format data series -> Row parameters -> Along the secondary axis) (Figure 10):

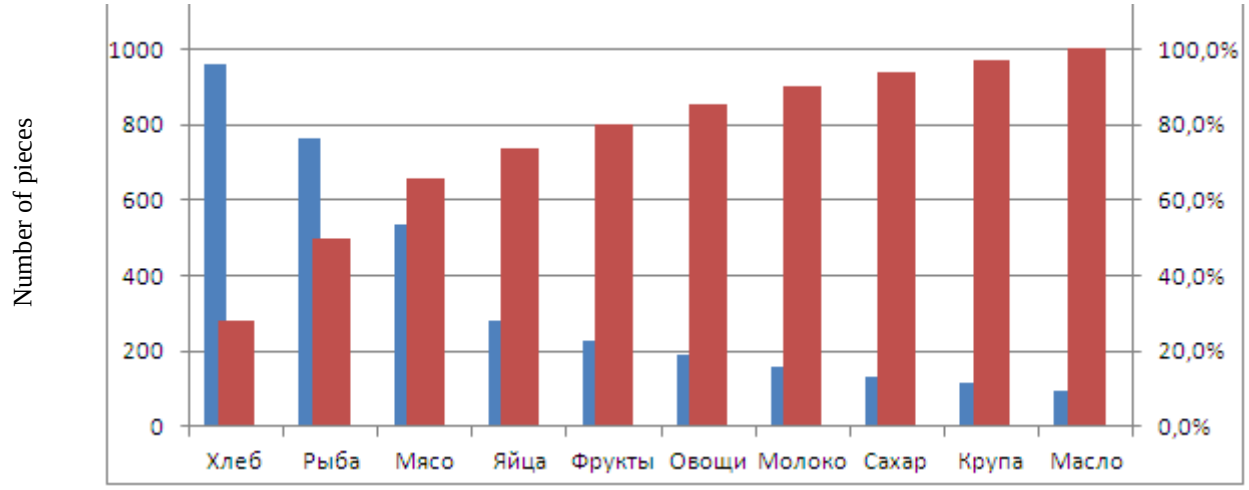

Figure 10 – Transferring the row to the auxiliary axis

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) (Figure 11):

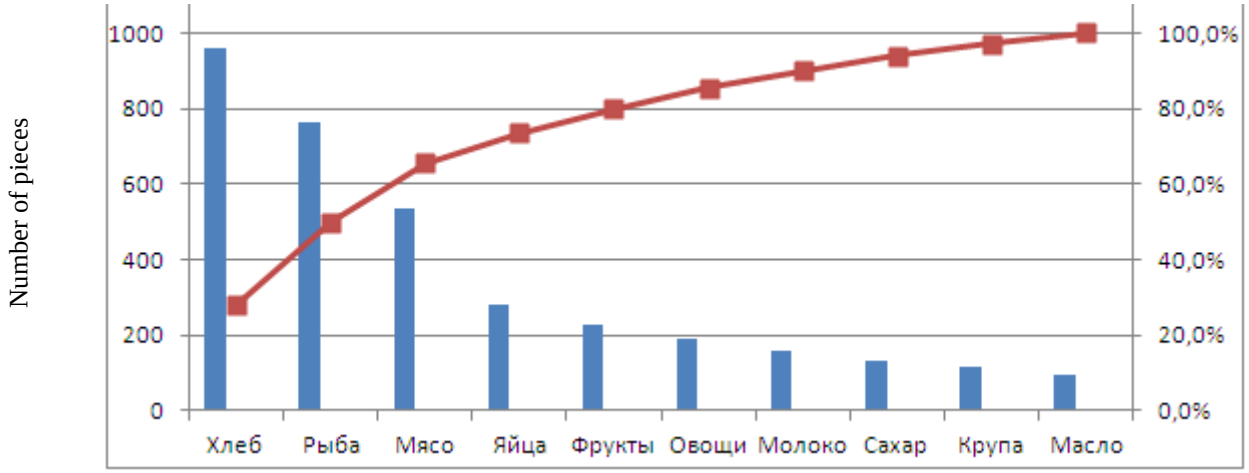

Figure 11 - Changing the type of chart for a series

Further, we carry out similar actions for the "Coefficient" series, which we transfer to the auxiliary axis and make it a horizontal line (Figure 12):

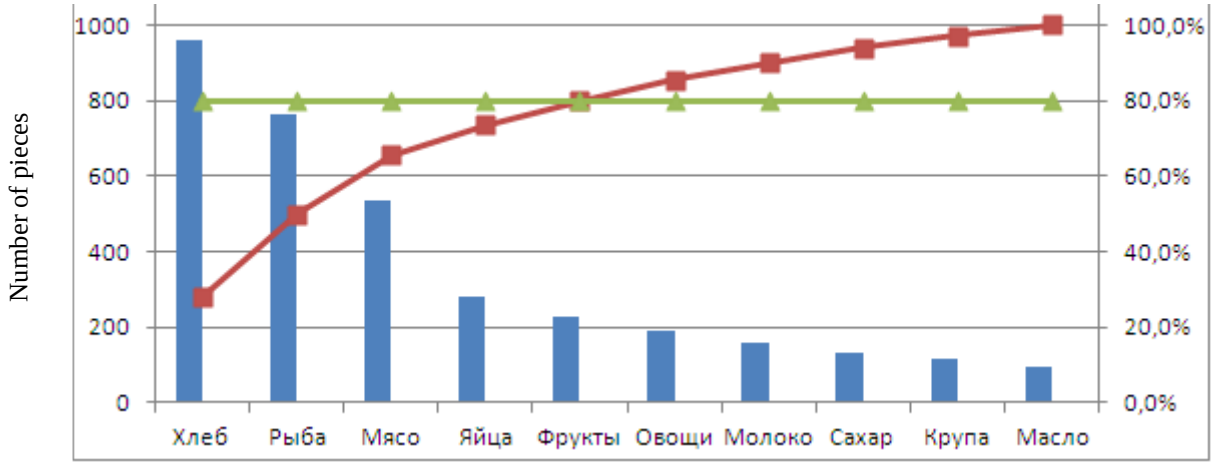

Figure 12 - Adding a horizontal line to the diagram

Let's add highlighting to the chart that shows which specific product groups bring the main profit. Select the "Highlight" row and transfer it to the secondary axis. Set the side clearance to 0 - right-click on the row, select Format data row -> Row parameters -> Side clearance (Figure 13):

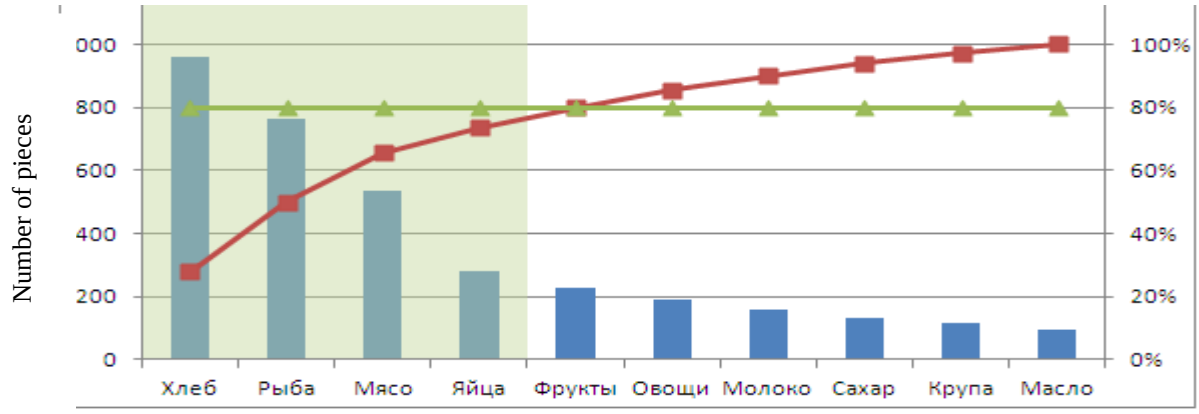

Figure 13 - An example of a Pareto chart in Excel for product sales data (Figure 3)

We customize the chart at our discretion and get the final look of the Pareto chart in Excel (Figure 114):

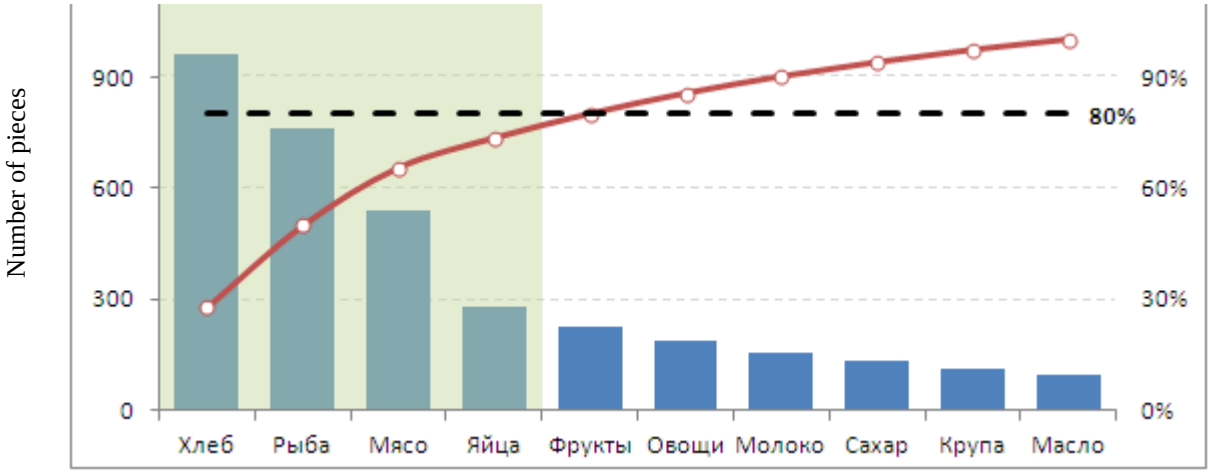

Figure 14 - The final view of the Pareto chart in Excel (wrong)

If Figures 12 and 13 are constructed correctly and the condition for the formation of the cumulative percentage is satisfied, the total value of which cannot be more than 100%, and scaling must be implemented in accordance with the rules for drawing up charts, namely: the scale of the right ordinate is set to 10% and the axis is split, thus, there are always only ten parts, which provokes the formation of the left ordinate axis, namely, choosing the scale ratio between the left and right ordinate axes 1: 1; 1: 2; 15; 1: 10; or 1: 1; 2: 1; 5: 1; 10: 1; then Figures 1.14 and 1.15 are incorrectly constructed.

The Pareto chart allows you to distribute efforts to resolve emerging problems and establish the main factors with which you need to start acting in order to overcome the problems that arise.

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

We customize the chart at our discretion and get the final look of the Pareto chart in Excel (Figure 15), but the plotted incorrectly - the ordinate axis has the designation 120%, and it should be no more than 100%

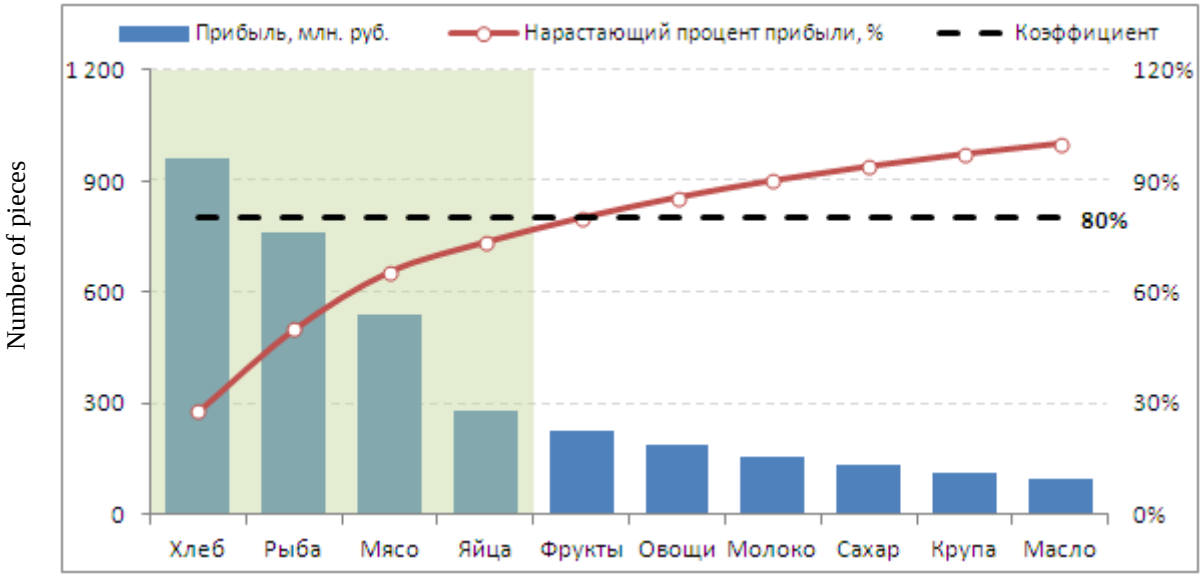

Figure 15 - The second option for building the final form of the Pareto chart in Excel

Let's clarify the stages of solving the problem of constructing a Pareto chart in Excel, namely:

Stage 1. First you need to decide:

1. What problems need to be investigated (e.g. defective products, money losses, accidents);

2. 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 combined under the general heading "other");

3. Determine the method and period of data collection.

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

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

Stage 4. Development of a table for checking data with columns for totals for each checked feature separately, the accumulated amount of the number of defects, percent of the total and accumulated interest (table 1).

Stage 5. Arrangement of the data obtained for each checked feature, in order of importance and filling out the table (table 1).

Table 1 - Results of data registration by types of defects for constructing a Pareto chart in Excel

Types of defects	Number of defects	Accumulated number of defects	The percentage of the number of defects for each feature to the total amount	Accrued interest
Deformation	104	104	52	52
Scratches	41	146	21	73
Sinks	20	166	10	83
Cracks	10	176	5	88
Stains	6	182	3	91
The gap	4	186	2	93
Other	14	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.

1. The vertical axis contains percentages, and the horizontal axis contains intervals in accordance with the number of controlled features.

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

Stage 7. Building a bar chart (Figures 17 and 18).

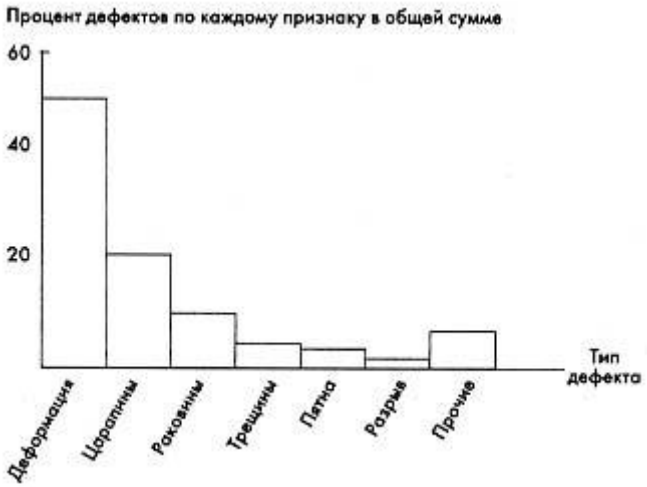

Figure 17. Pareto Chart

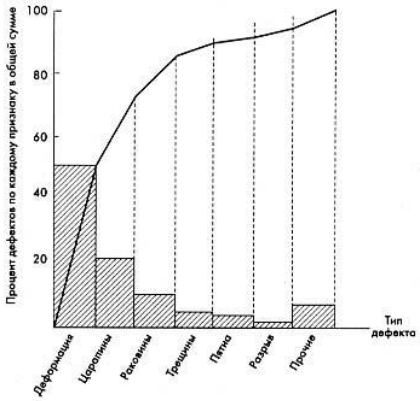

Figure 18. Cumulative Curve in Pareto Chart

Stage 8. Drawing a cumulative curve (Pareto curve) on the diagram (Fig. 1.18).

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 from the results, it is important to determine the causes of its 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. The relative percentage of Group A in the total number of defects (causes) is usually 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%;

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

An example of using ABC analysis within the Pareto chart is shown in Figure 19.

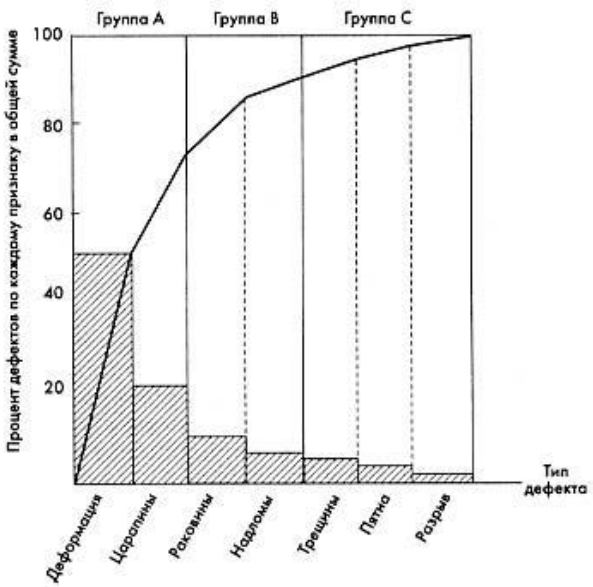

Figure 19 - An example of the use of ABC - analysis in the framework of the Pareto chart

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

Enterprises of the Russian metallurgical industry have actively engaged in the development, implementation and certification of quality systems for compliance with international standards ISO 9000 series. This industry is characterized by problems that currently exist in all sectors of the country's economy, namely, due to a significant decline in production use of production facilities. The metallurgy market is not monopolized, but highly concentrated. The share of deliveries of metallurgical products to non-CIS countries is also high. Therefore, for the enterprises of the industry, the task of introducing and certifying quality management systems for compliance with international standards ISO 9000 series is very relevant.The history of Lipetsk has always been closely associated with ferrous metallurgy. The first factories appeared here at the end of the seventeenth century. Cast iron was smelted from local iron ores, from which cannons, cannon balls and anchors were made for the Petrovsky fleet. These factories existed until the end of the 18th century. Metallurgy received further development here only at the beginning of the twentieth century with the construction of first the Sokolsk and then the Novolipetsk metallurgical plant. NLMK Group announced a new stage of development with the start of Strategy 2017, which is aimed at unlocking the company's internal potential by increasing the operational efficiency of the production chain, strengthening vertical integration in key raw materials, increasing sales of high value-added products, and continuing programs in the field of environmental protection, industrial safety and human capital development.

As an object of production, a rectangular forging made of carbon steel by free forging and using backing dies was selected. The external view of the forging is shown in Figure 20.

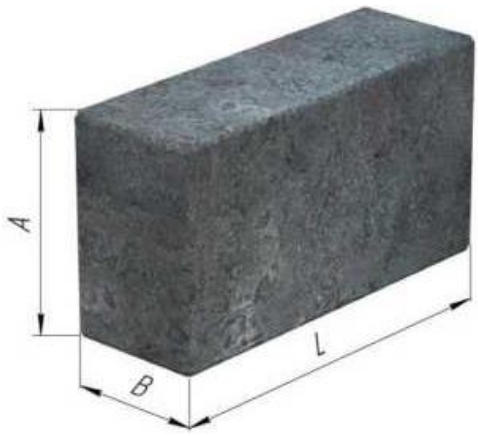

Figure 20 - Rectangular section forging:
A- height, mm; B - width, mm; L - length, mm.

Forgings are manufactured in accordance with GOST 8479-70 “Forgings from structural carbon and alloy steel. General technical conditions ".

Forgings are used for the manufacture of machine parts and spare parts for metallurgical, mining and machine-building equipment: blast furnace charging rods, shroud rings, gear shaft, gear and crane wheels, MH / 13 rollers, metal-cutting knives, etc.

For the manufacture of forgings, the following steel grades are used from ingots of our own production, as well as from purchased rolled products and customer material: 15, 20, 35, 45, 40X, 65G, 40XN, 35XM, 40X1MFA, 18XGT, 38XGN, 38XGSA, ZOHGSA, 10XSND, 5XNM , 34XH1M, 34XH3M, 40XH2MA, ХВГ, Х12М, Х12Ф1, 20Х13, 30Х13, 12Х18Н9Т, 12Х18Н10Т, 5ХВ2СФ, 6ХВ2С, 24Х1М1Ф.

Technical characteristics of the forging are presented in table 2.

Table 2 - Technical characteristics of forgings manufactured by OJSC "NLMK"

Forgings type	Blank	Parameters of forgings, mm	Weight forgings, Kg	Regulatory documentation
Rectangular cross-sections	Press broach	A, B 40-400; L 100-4000.	Up to 1700	GOST 8479-70
	Ingot m = 1.6 t.	A, B 100-300; B <L <3000; A <B <2.5A.	Up to 1000	

Forgings are manufactured in accordance with the requirements of GOST 8479-70 according to drawings approved in the prescribed manner, and regulatory and technical documentation for specific products. Forgings by type of testing are divided into groups indicated in Table 3.

Table 3 - Groups of forgings by test type

Group of forgings	Types of tests	Batch picking conditions	Delivery characteristics
1	2	3	4
I	No tests	Forgings of one or different steel grades	-
II	Determination of hardness	Forgings of the same steel grade, jointly heat treated	Hardness
III	Determination of hardness	Forgings of the same steel grade, heat treated in the same mode	Also
IV	1. Tensile test 2. Determination of impact strength 3. Determination of hardness	Forgings of one steel heat, jointly heat treated	Yield point Relative narrowing Impact strength
V	1. Tensile test 2. Determination of impact strength 3. Determination of hardness	Each forging is individually accepted	Yield point Relative narrowing Impact strength

The assignment of the forgings to a particular group is made by the consumer, the group number is indicated in the technical requirements on the part drawing.

The type, volume, norms and methods of additional tests are indicated in the drawing of the forging or in the order.

The dimensions of forgings should take into account machining allowances, dimensional tolerances and technological overlaps for forgings manufactured by forging on presses in accordance with GOST 7062-79, manufactured by hammer forging in accordance with GOST 7829-70 and manufactured by hot stamping in accordance with GOST 7505-74, as well as overlaps for samples for control tests.

Hardness standards for group II and III forgings and strength categories for group IV and V forgings are established by agreement between the manufacturer and the consumer. The steel grade is established by agreement between the manufacturer and the consumer and is indicated on the drawing of the part and forging.

There should be no cracks, shackles, films, sands on the surface of the forgings.

On untreated surfaces of forgings, dents from scale and nicks are allowed, as well as shallow cutting or cleaning of defects, provided that the depth of these defects does not exceed the limits of the smallest allowable dimensions of forgings in accordance with GOST 7062-79.

Defects are not allowed on the surfaces of forgings being chased. On the machined surfaces of forgings, individual defects are allowed without removal if their depth, determined by control punching or stripping, does not exceed 75% of the actual one-sided allowance for machining for forgings produced by forging, and 50% for forgings produced by stamping. On forgings made of carbon and low-carbon steel, with a depth of surface defects exceeding the actual one-sided allowance for machining, it is allowed to remove defects by gentle cutting with subsequent welding.

The permissible brewing depth must be agreed with the consumer.

Forgings should not have flakes, cracks, shrinkage looseness, the absence of which is guaranteed by the manufacturer.

Forgings in which the above defects are found are rejected, and all other forgings of this batch can be recognized as suitable only after individual control, the number of packages manufactured at OJSC Novolipetsk Metallurgical Plant per year reaches up to 1,500,000 pieces. A quality management system that meets the requirements of the international standard ISO 9001-2015 has been implemented at OJSC Novolipetsk Metallurgical Plant.

The quality management system of NLMK includes:

- the management structure of the Managing Director of NLMK OJSC and the management structure of the structural divisions of NLMK OJSC;

- processes of the NLMK Quality Management System, their application, consistency and interaction;

- documentation of the NLMK Quality Management System, containing the requirements in accordance with which personnel perform activities in the field of quality, and records (data) confirming the fulfillment of these requirements;

- the resources required for the efficient and effective functioning of the processes and the Quality Management System of NLMK as a whole.

The quality management system of NLMK operates on the basis of processes covering all types of activities that determine the quality of products. The top management of NLMK OJSC defines and forms the governing, main and auxiliary processes, as well as processes aimed at continuous improvement of the NLMK OJSC Quality Management System. The tasks of defining the structure of processes, their documenting as a means of ensuring the implementation of NLMK's Quality Policy, achieving goals and product compliance with established requirements are being addressed.

The quality management system of NLMK operates as follows:

- top management determines the priority areas of NLMK's activities, formulates the NLMK Group's Quality Policy and NLMK's goals in terms of quality. NLMK Group's quality policy is approved by the President (Chairman of the Management Board);

–NLMK's Managing Director approves quality objectives, holds a meeting of NLMK's management to analyze the functioning of the quality management system;

- the authorized management of NLMK for the Quality Management System heads all work on organizing the functioning and improvement of the quality management system of NLMK in accordance with the requirements of the Regulations on the authorized management of NLMK for the quality management system;

–The technical center coordinates the development and implementation of normative documents of the quality management system, organizes and conducts internal audits of technological processes and products, participates in the organization of external audits of the QMS, prepares information on the functioning of the quality management system for analysis by the management of NLMK;

–The Center for Management Systems and Scientific and Technical Information (CSMSTI) organizes and conducts internal audits of the quality management system, organizes external audits by certification bodies;

- heads of structural divisions, appoint a responsible structural division for the quality management system, organize the activities of personnel to meet the requirements of the quality management system;

–Responsible structural units for the quality management system in accordance with the requirements of the "Regulations on the responsible structural unit for the quality management system" organize work for the effective functioning and continuous improvement of the quality management system in structural units;

–Responsible for document management of the Quality Management System in the structural divisions of OJSC NLMK provide personnel with regulatory documents of the quality management system;

–The personnel of structural divisions carry out activities in accordance with the requirements of the quality management system.

NLMK's quality management system documentation is formed in accordance with the requirements of the legislation of the Russian Federation and interstate, national (state) standards of the Russian Federation, as well as taking into account the requirements of international standards ISO 9001 and ISO / TS 16949 and consumer requirements.

NLMK's Quality Management System documentation includes:

–Formed by the top management of NLMK and approved by the NLMK Group Quality Policy and quality objectives.

–NLMK Quality Manual, which defines the Quality Management System of NLMK in accordance with the requirements of ISO 9001 and ISO / TS 16949;

–Process maps that establish the goal of the process, inputs and outputs of the process, the main stages of its implementation, resources, parameters and control methods; process performance indicators and performance indicators (for main and auxiliary processes), current documents, in accordance with the requirements of which activities are carried out on this process;

- standards for the organization of the quality management system, which establish the procedures for the quality management system of NLMK;

- documents developed in accordance with the requirements of the enterprise quality management system standards (regulations on structural units, job and production and technical instructions, technological instructions, flow charts of technological operations, technological maps, technical specifications, product standards, etc.);

–Organizational and administrative documents (orders, orders of the management of OJSC NLMK).

The structure of documenting the quality management system of NLMK is shown in Figure 121.

⁎ planning the level of product quality, planning quality control and technical controls;

⁎collecting quality information, determining the cost of quality assurance, processing information and analyzing quality data from production and operations;

⁎quality management of products supplied by suppliers and products of our own enterprise;

⁎development of control methods to ensure comparability and reliability of quality control results;

⁎development (together with technical departments) of technical conditions, conditions, standards for product quality management.

Quality control includes:

⁎incoming quality control of raw materials, basic and auxiliary materials, semi-finished products, components, tools supplied to the warehouses of the enterprise;

⁎production operational control over compliance with the established technological regime, and sometimes inter-operational acceptance of products;

⁎systematic monitoring of the condition of equipment, machines, cutting and measuring instruments, control and measuring instruments, precision measuring instruments, stamps, models of testing equipment and weighing facilities, new and in operation devices, conditions of production and transportation of products and other checks;

⁎control of models and prototypes;

⁎control of finished products (parts, small assembly units, sub-assemblies, assemblies, blocks, products).

Quality promotion covers:

⁎development of documentation reflecting methods and means of motivation in the field of product quality assurance;

⁎development of regulations on bonuses to employees of the enterprise for the quality of work (together with the department of labor organization and wages);

⁎training and professional development.

The characteristics of forging defects are shown in Table 4.

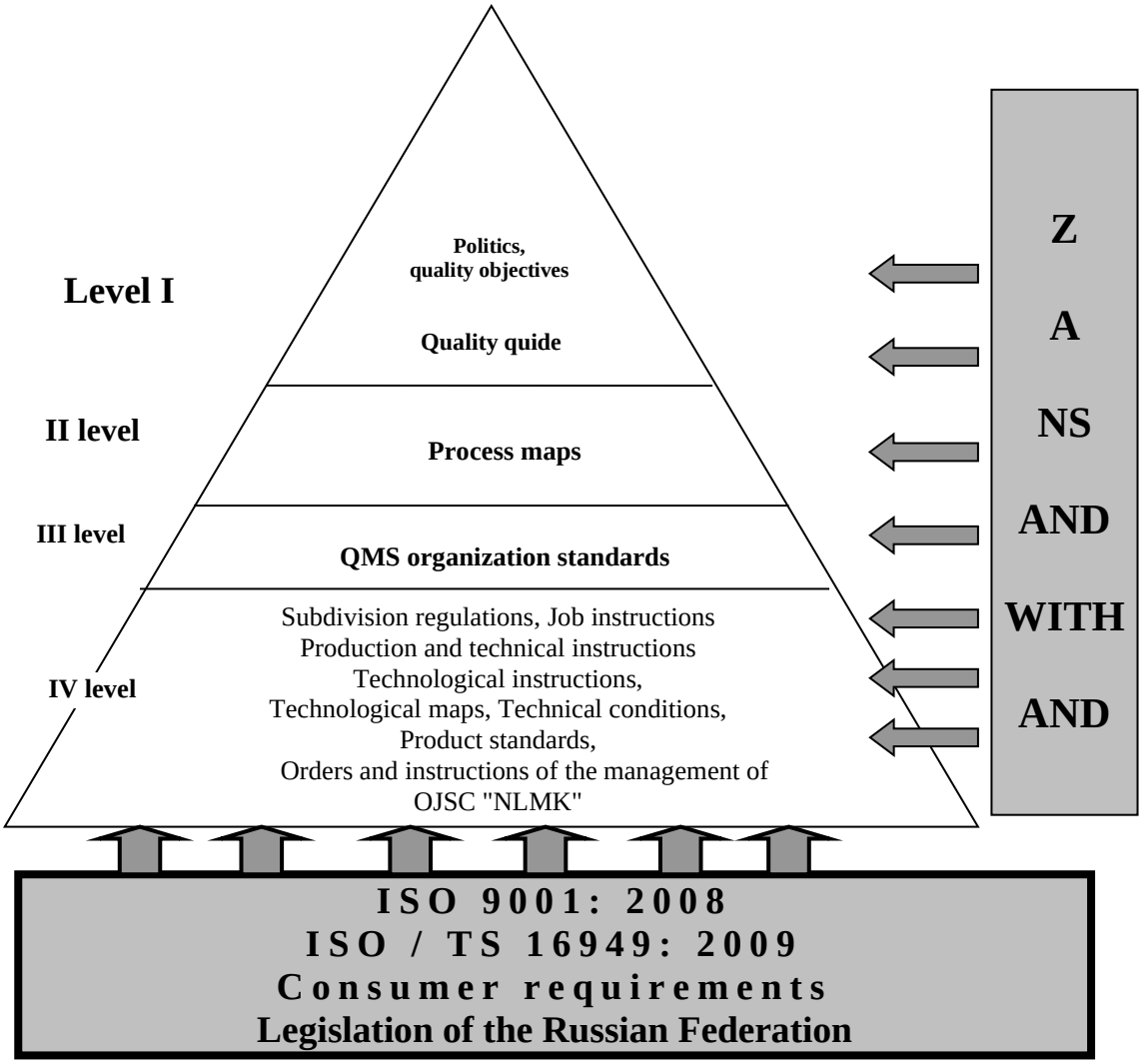

Figure 21 - The structure of documentary registration of the quality management system of OJSC "NLMK"

Table 4 - List of forging defects

No. p / p	Type of product defect	Defect characteristic	The cause of the defect	Defect elimination method	The culprit of the defect
Heating defects					
1	Scale	The surface of the forging is covered with a layer of oxidized metal	1 High heating temperature 2 Excessively long heating time	Descaling the workpiece	Heater
2	Underheating	Internal cracks in the workpiece	1 High heating rate 2 Insufficient holding of the workpiece in the heating furnace	When cracks appear, the defect is not eliminated	Heater

3	Overheat	Excessive grain growth in steel and decreased mechanical properties	1 Heating to temperatures exceeding the allowable for a given steel grade 2 Excessive heating time to required forging temperatures 3 End of forging at high temperatures well above the optimum	Overheating is eliminated by normalization, annealing or improvement	Heater
4	Burned	Oxidation or melting along the grain boundaries of steel, characterized by abundant emission of sparks from a white-hot workpiece	Long-term heating at high temperatures (1300-1350˚C)	Burn-in forgings cannot be repaired	Heater
Forging defects					
5	Clamps	Chained folds of metal on blanks	1 The use of incorrect techniques for broaching and disperse workpieces	If there are tolerance limits, remove forgings by fire stripping.	Blacksmith
6	Concave ends	The ends of the forging appear in the form of a "bootleg"	1 Active feed of a workpiece with a circular cross-section 2 Insufficient heating of the workpiece 3 Low weight of the falling parts of the hammer 4 Insufficient length of the pull-off end	1 Feed with moderate feed 2 Heating the workpiece according to the modes 3 Forging should be done on a heavier hammer 4 Correctly calculate the volume of metal required for a given forging	Blacksmith, heater, foreman, technologist

7	External cracks or flaws	Cracks and flaws	1 Forging at low temperatures 2 Rapid cooling of forgings (especially alloy steels) 3 Inadequate heating of the workpiece, causing severe burnout or overheating of the workpiece surface 4 Poor quality of the original ingot or billet 5 Inhomogeneity of the chemical composition of the ingot or billet over the section	1 Heat metal for forging in accordance with the normative technological documentation (NTD) 2 Cooling should be done according to NTD	Blacksmith, heater, ingot (billet) manufacturer
8	Internal breaks	When forging metal, holes appear in the central zone of the section of the forging	1 Forging metal at high feed rates 2 Rolling round billets in flat strikers 3 Significant settlement in flat strikers with large contact surfaces and low height of the upset forging	1 Forge the workpiece at low feed rates 2 Run in a round workpiece in cut-out strikers 3 It is necessary to correctly calculate the initial blank for upsetting	Blacksmith, technologist
9	Curvature	The geometric surface of the forging is curved	1 Broaching an unevenly cooled billet during forging and non-observance of the order of tilting the billet 2 Under the action of its own weight, the forgings of long shafts 3 Upsetting of an unevenly heated workpiece 4 Excessive ratio of forging length to diameter	Straightening of forgings	Blacksmith, heater, technologist
10	Insufficient uk.	The presence of a large crystalline cast structure in the forging	The ratio of the sectional area of the ingot to the sectional area of the forging does not correspond to the forging ratio	Correctly calculate the selection of the original workpiece	Technologist

11	Internal breaks	When forging metal, holes appear in the central zone of the section of the forging	1 Forging metal at high feed rates 2 Rolling round billets in flat strikers 3 Significant settlement in flat strikers with large contact surfaces and low height of the upset forging	1 Forge the workpiece at low feed rates 2 Run in a round workpiece in cut-out strikers 3 It is necessary to correctly calculate the initial blank for upsetting	Blacksmith, technologist
12	Curvature	The geometric surface of the forging is curved	1 Broaching an unevenly cooled billet during forging and non-observance of the order of tilting the billet 2 Under the action of its own weight, the forgings of long shafts 3 Upsetting of an unevenly heated workpiece 4 Excessive ratio of forging length to diameter	Straightening of forgings	Blacksmith, heater, technologist
13	Insufficient uk.	The presence of a large crystalline cast structure in the forging	The ratio of the sectional area of the ingot to the sectional area of the forging does not correspond to the forging ratio	Correctly calculate the selection of the original workpiece	Technologist
14	Dents	Traces in the form of stepped transitions and dents from strikers, traces of scale pressed into the body of the forging	Careless work in the manufacture of forging	Increase the responsibility of personnel for the quality of products	Blacksmith
15	The geometric dimensions of the forging are not maintained	Deviation of the forging from the specified dimensions and tolerances.	1 Incorrectly dimensioned original blank 2 Unsustained dimensions of forging tolerances during forging	1 Calculate expertly the original workpiece 2 Forgings are made according to NTD	Technologist, blacksmith
16	Indicators of mechanical properties of the forging are not maintained	Deviations from NTD requirements after heat treatment: ultimate strength and yield strength; relative elongation or	1 Incomplete hardening 2 Excessive holiday temperature 3 Decarburization of the forging surface during repeated heating	Heat treatment of forgings is carried out in accordance with the approved schedule	Technologist, master

		compression; impact strength and hardness on forgings or samples	4 Inconsistency of the chemical composition of the metal of the workpiece		
17	Dents	Traces of scale stamped and then removed from the forging with a depth of up to 3 mm	Negligence in the work of a blacksmith	1 It is necessary to thoroughly clean the scale from the heated workpiece before stamping 2 Re-stamping	Blacksmith
18	Nicks	Mechanical damage to forgings	Bottoms appear when forgings are removed from dies in the event of jamming or when foreign objects get into edging dies	It is necessary to lubricate the figure of the stamp, as well as to prevent the ingress of foreign objects on the stamps	Blacksmith
19	Scrap Boy	Fatal damage to the forging	Impact when the forging is displaced from the bottom shape of the stamp when punching or cutting a burr	Observe the correct installation of the forging in the dies	Blacksmith
20	Not filling a figure	Deviation from the specified geometrical dimensions of the forging due to non-filling of the finishing die at projections, corners, roundings and ribs	Insufficient heating of workpieces or insufficient number of punching blows, improperly designed die, insufficient weight, length or inappropriate workpiece profile	Eliminate re-stamping	Blacksmith,. technologist, constructor
21	Under stamping	Increase of all dimensions of the forging in excess of the tolerance in the direction perpendicular to the main plane of the part.	1 Insufficient heating blanks 2 Insufficient number of blows in the final result or insufficient mass of the falling parts of the hammer 3 Enlarged workpiece profile	Re-stamping or preliminary roughing of forgings before machining	Blacksmith, technologist

22	Skew	Displacement in excess of the specified tolerance of one half of the forging relative to the other along the split plane	Equipment malfunction (increased clearance of the guides, development of the planes of the stamp holder) or stamps (knocked down locks, the development of fastening planes), poor installation and fastening of the stamps	In some cases, by re-stamping, and a slight misalignment - by sharpening the base surfaces of the forgings	Blacksmith, mechanic
23	Clamp	Stamped crease resulting from improper metal flow in the finishing stream or rolling of burrs resulting from improper execution of the first punching passes	Eccentric stacking of workpieces in the die strand, excessively sharp blows in the broaching or rolling strands, inconsistent sizes of the roughing and finishing strands	Minor clamps are removed by sharpening with a circle or punching out with a chisel	Blacksmith, technologist, constructor
24	Burr	Uncut flash residue	Unsatisfactory installation and adjustment of stamps	Removed by sharpening with an emery wheel	Blacksmith, adjuster
25	Curvature	Deviation of the axes and planes of the forging from their correct geometric position	1 Occurs when cropping burrs for forgings with a complex trimming contour, with thin sections and long lengths 2 Use of faulty trimming punches or dies of improper design, as well as when extracting forgings from dies and their heat treatment	Curvature is eliminated by cold stamping or hand-fitting with a template	Blacksmith, technologist, constructor

26	Looseness in size	Lack of allowance for cutting or reduction of the working section of the part in non-machined places	1 Stamping of forgings with a thick layer of scale or in worn out dies 2 Excessive mass of falling parts of the hammer 3 Incorrect adjustment of cutting dies (one-side cut)	Not corrected.	Blacksmith, technologist, adjuster
27	Clamp	Stamped crease resulting from improper metal flow in the finishing stream or rolling of burrs resulting from improper execution of the first punching passes	Eccentric stacking of workpieces in the die strand, excessively sharp blows in the broaching or rolling strands, inconsistent sizes of the roughing and finishing strands	Minor clamps are removed by sharpening with a circle or punching out with a chisel	Blacksmith, technologist, constructor
28	Burr	Uncut flash residue	Unsatisfactory installation and adjustment of stamps	Removed by sharpening with an emery wheel	Blacksmith, adjuster
29	Curvature	Deviation of the axes and planes of the forging from their correct geometric position	1 Occurs when cropping burrs for forgings with a complex trimming contour, with thin sections and long lengths 2 Use of faulty trimming punches or dies of improper design, as well as when extracting forgings from dies and their heat treatment	Curvature is eliminated by cold stamping or hand-fitting with a template	Blacksmith, technologist, constructor
30	Looseness in size	Lack of allowance for cutting or reduction of the working section of the part in non-machined places	1 Stamping of forgings with a thick layer of scale or in worn out dies 2 Excessive mass of falling parts of the hammer 3 Incorrect adjustment of cutting dies (one-side cut)	Not corrected.	Blacksmith, technologist, adjuster

31	Length deviation	-	The consequence of different temperature shrinkage in the volume of forgings during stamping or instability of the length of the workpieces, improper design and installation of stops for dies during upsetting and bending	Not corrected	Constructor, adjuster

The number of detected defects in the forging for 2020 is shown in Table 5, and in Figure 22, the constructed Pareto chart for the identified defects for 2020, the expected number of defects in 2021 is given in Table 6, and the constructed Pareto chart in Figure 23.

Table 15 - Characteristics of forging defects (2020) (pieces)

The name of the defects revealed in the forging	The number of defects found in the forging	Accumulated share of detected defects in forging	The total number of detected defects in the forging (cumulative percentage)
Underheating	15200	15%	15%
Burned out	13600	14%	29%
Looseness in size	12800	13%	42%
Length deviation	10500	10%	52%
Concave ends	9700	10%	62%
External cracks or holes	8300	8%	70%
Internal breaks	7200	7%	77%
Insufficient uk	6400	6%	83%
Dents	5600	6%	89%
The geometric dimensions of the forging are not maintained	4800	5%	94%
Skew	3850	4%	98%
Other	2050	2%	100%
Total	100,000		

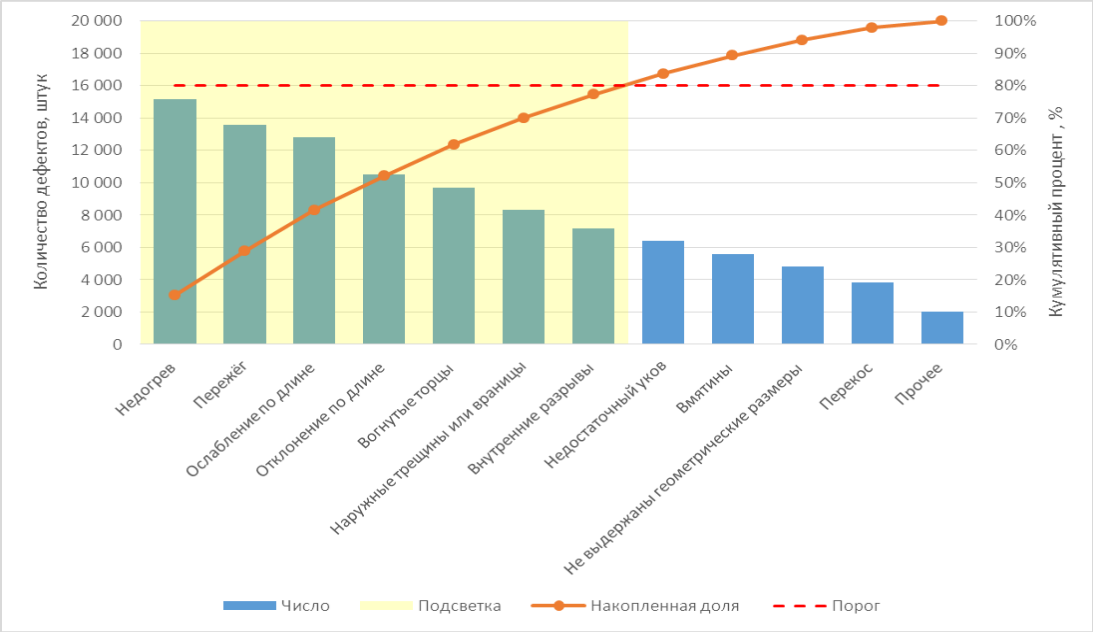

Figure 22 - Diagram for defects in products manufactured by NLMK for 2020

Table 6 - Characteristics of forging defects (2021) (pieces) (expected)

The name of the defects revealed in the forging	The number of defects found in the forging	Accumulated share of detected defects in forging	The total number of detected defects in the forging (cumulative percentage)
Scale	1510	19%	19%
Overheat	1,430	17%	36%
Clamps	1,300	13%	49%
Curvature	1 180	11%	60%
Indicators of mechanical properties of the forging are not maintained	1 170	9%	69%
Dents	1 110	7%	76%
Slaughtered	1,050	6%	82%
Scrap Boy	1,000	5%	87%
Unfilled shapes	930	3%	90%
Under stamping	900	2%	92%
Curvature	880	2%	94%
Other	410	6%	100%
Total	12 870	100%	

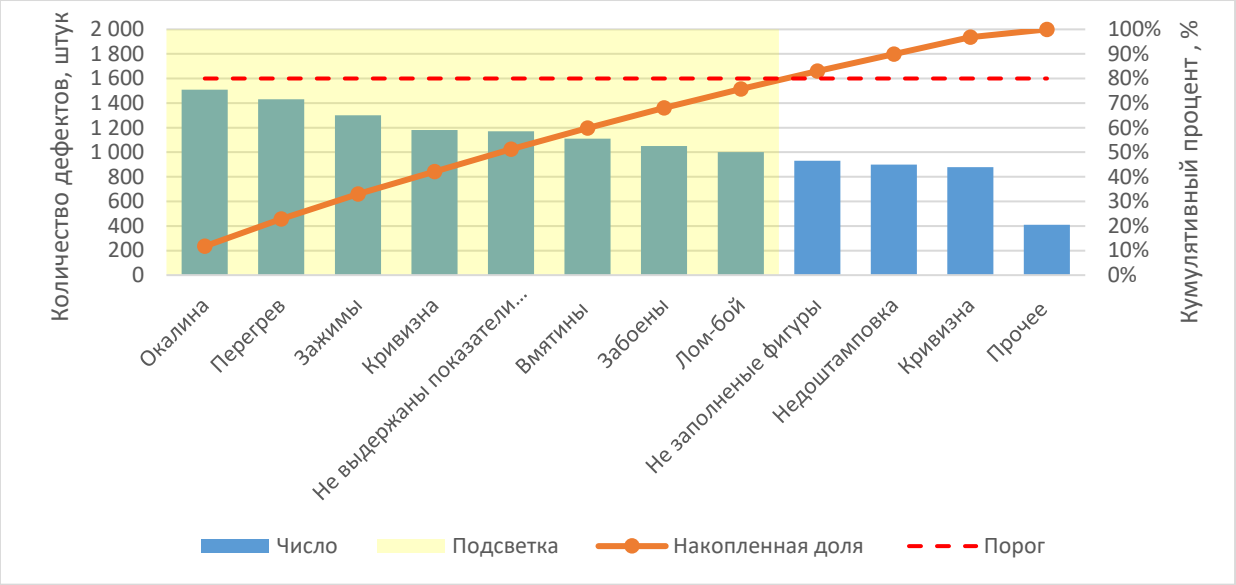

Figure 23 - Diagram for defects in products manufactured by NLMK for 2021 (expected)

Production efficiency is the ratio between the results obtained in the production of products, on the one hand, and the cost of labor and means of production, on the other. It is the most important quality indicator of the economy, its technical equipment and labor qualifications. Comparison of costs and benefits is used in the practice of managing firms, enterprises and other economic entities.

The main indicators of production efficiency are: labor productivity; capital intensity of a unit of GDP or specific types of products; return on assets of a unit of fixed assets; material consumption per unit of GDP or specific types of products; the ratio of extensive and intensive factors in GDP growth; competitiveness of manufactured products; payback period, etc.

Efficiency is understood as the correspondence between the social effect of the application of the results of standardization work in production and the costs associated with their application.

Product quality assurance comes with a cost. The quality of the product should guarantee the consumer satisfaction of his needs, its reliability and cost savings. These properties are formed in the course of the entire reproductive activity of the enterprise, at all its stages and in all links. Together with them, the value of the product is formed, which characterizes these properties from planning product development to its implementation and after-sales service.

Reclamation is a claim made by the buyer to the seller in connection with the discrepancy between the quality or quantity of the supplied goods with the terms of the contract. Complaints can only be made on such issues that were not the subject of acceptance of the goods, made in accordance with the terms of the contract.

The policy of the enterprise should initially aim at high quality products. However, marriage, which is its opposite, can occur in any enterprise. It must be taken into account. Defects can be found in the manufacturing enterprise itself and outside of it. A defect that manifests itself in the field of sale or in the process of using products indicates both the poor quality of the product and the quality of the enterprise. Complaints are compared in terms of cost and quantity with the previous period. They are calculated for 100, 1000, 10000 products, depending on the volume of production. The appearance of complaints causes the manufacturer not only material, but also moral damage, affecting his reputation.

The purpose of developing an enterprise organization standard is:

- reduction of marriage;
- improving the quality of production.
- increasing the volume of sales.

The volume of sales of products manufactured by the NLMK Repair Facility O1p is 14 million rubles.

Losses from complaints amount to 2.4% of the sales volume.

The costs for the development and implementation of the standard, according to the enterprise, amounted to 537,650 rubles. (Ztek).As a result of the introduction of the organizational standard, the quality of NLMK's products will increase, which will reduce losses from claims and fines up to 1.2%.

The savings from reducing the marriage Eb, rubles, is determined by the following formula:

$$Э_б = \frac{a_1 - a_2}{100} \cdot O_p, \qquad (1)$$

where a1 and a2 are the percentage of rejects before and after the implementation of measures,%.

$$0\ Эб = \frac{2{,}4 - 1{,}2}{100} \cdot 14000000 = 1680000 \text{ rubles.}$$

The results obtained confirm the effectiveness and feasibility of development and implementation STO SMK XX. XXX-2016 "Management of nonconforming products in the NLMK Repair Facility "using the Pareto chart.

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 quality control methods using the Pareto chart creates the basis for their reliability and guarantees enterprises to ensure competitiveness and import substitution with their products.

The quality of import-substituting products that are offered to consumers in the regions of the Southern Federal District and the North Caucasus Federal District depends not only on Russian producers, but also due to an ineffective model of market control from illegal goods that enter these markets through the uncontrolled border of illegal imports of products (for example, through the border of Kazakhstan) hazardous to the health of consumers The Ministry of Industry and Trade of the Russian Federation introduced marking of fur products and marking by means of identification and monitoring of the turnover of import-substituted products in order to exclude the ingress of counterfeit products and significantly reduce the share of counterfeit products while improving the quality of domestic imports of substituted goods, including through the use of statistical methods quality control using the Pareto chart.The quality improvement results achieved are summarized below.

The reason for the development of the QMS is the awareness of the new realities of the market. Now the presence of a certified QMS is practically becoming a necessity: this is a mandatory requirement of some customers when concluding contracts, this is a mandatory requirement for participation in most tenders. Voluntary certification of the QMS is gradually becoming a necessity for manufacturers, in fact, becoming mandatory. That is why QMS is one of the stages in the development of every modern enterprise. When developing a QMS, it is necessary to coordinate management activities in relation to quality, thereby strengthening the relationship of all structural divisions.

Economic effect Eph, rubles, according to the following formula:

$$Ef = Eb - Ztek, \qquad (2)$$

where *Esoch* –Saving from a decrease in rejects, rubles;

Ztek - current costs, rub.

Ef = 1680000 - 537650= 369650 rubles.

However, the task of creating an efficiently functioning quality management system should be solved, first of all, at the level of a particular enterprise, taking into account its characteristics determined by the field of activity, the current financial condition, the existing level of implementation of consistency in work on quality assurance, etc.

Currently, the number of enterprises implementing a quality management system based on the ISO 9000 series has increased dramatically, which is facilitated by a number of circumstances, the main of which are:

organization of work on the implementation of quality systems is an important element of several federal programs;⁎

when creating joint ventures, foreign firms and companies often set a prerequisite: preparation and operation of a quality system in accordance with the ISO 9000 series standards;⁎

⁎ enterprises of various industries seeking to export products are faced with the problem of introducing ISO standards and certification of quality systems for compliance with these standards during contract negotiations, and also in a number of countries it becomes difficult to sell products without confirming the stability of quality during their release;

creation of more favorable conditions for insurance, obtaining a loan, investment, participation in tenders, competitions and other events that may end with a contract; ⁎

the executive discipline at the enterprise is increased, the motivation of employees is improved, the losses caused by defects and inconsistencies are reduced;⁎

the enterprise becomes more "transparent" for management, in this regard, the quality of management decisions increases;⁎

A number of problems that the company faces on the way to create a quality management system, namely:

⁎the specialists of our enterprises have no real experience of work in the conditions of market relations. During the certification of quality systems, the lack of such experience is observed in many forms, namely: in the inability to establish effective feedback with consumers; lack of skills in the assessment and selection of suppliers; in an unclear distribution of responsibility between managers of different levels; in duplication of some processes, etc .;

⁎Taking managerial decisions on the implementation of quality assurance activities, the heads of enterprises pursue the goal of not creating an efficiently functioning quality system, which will actually guarantee the quality of products in accordance with the needs and expectations of consumers, namely, obtaining a certificate, certificate. The external market for domestic enterprises that do not have a quality system based on the ISO 9000 series is practically closed. Therefore, the administration of enterprises is primarily interested in the timing of obtaining an international certificate of quality. And issues related to the volume of labor, material, technical and financial resources required for the implementation and certification of the quality system and, most importantly, to ensure its cost-effective operation, fade into the background;

⁎the appointment of specialists for the development and implementation of quality management systems according to the international quality management system by the management of an enterprise is often carried out without proper selection of candidates and understanding of the criteria that these candidates must satisfy.

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.

The domestic industry is going through hard times, and the consumer is offered products of dubious quality that have entered our markets by counterfeit and other illegal ways, that is, they have no guarantees for buyers to exercise their rights to protect themselves from unscrupulous manufacturers and suppliers.

To reanimate the role and importance of a quality-oriented strategy, since only in this case business leaders will subjectively and objectively have to improve their production using nanotechnology, innovative processes and digital production, so that competitive and import-substituting materials and products fully meet the needs of domestic consumers. At the same time, our statement is substantiated that the consumption of domestic materials and products is regulated by the market. In this case, market requirements should shape the role of the state and consumers in production in the formation of sustainable demand for domestic materials and products, namely:

maintain a range of goods, regulating it by federal, regional and municipal orders;

stimulate price stability;

increase consumer ability and gradually improve their quality. The implementation of these tasks will create the basis for the consumer to realize the need to pay for the advantages of high-quality materials and products, and the manufacturer to realize that improving the quality of materials and products cannot be associated only with rising prices, but also due to technical innovations in digital production, aimed on the use of new technological and engineering solutions.

Today, and even more so tomorrow, it is important to implement one of the defining principles of production efficiency - the manufacturer produces exactly what is needed not only for domestic, but also for foreign consumers.

It is no less important to understand the role and significance of quality activities, that is, how much the leaders got into the essence of things, learned how to manage things, change their properties (assortment), form, forcing them to serve a person without significant damage to nature, for the good and in the name of man.

Both political leaders and the government have recently started talking about the need for a competent industrial policy. However, if we carefully consider the normative, methodological documents on the restructuring of industry, then the thought arises whether we are not stepping on the same rake here that we have been stepping on during all the years of reforms.

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

These are the fight against inflation, the strengthening of the national monetary unit and financial stabilization. This is a change in the forms of ownership in various spheres of the economy through the process of privatization. This is a restructuring of the economy under the conditions of market relations.

Moreover, all these fundamental processes of economic reform must be based on structural adjustment. Both financial stabilization and privatization should be subordinate to the process of structural adjustment, since it is structural adjustment that determines the final result of reforms and the effectiveness of adaptation of various forms of production to civilized market relations.

The end result should also be the basis for the restructuring of the economy. And these are products, services - their competitiveness in the domestic and world markets.

What happened in the Russian reforms? All three basic processes (financial stabilization, privatization and restructuring) went on their own, without interconnection. Therefore, the methods used by the government and the Central Bank to combat inflation and other economic indicators often ran counter to the tasks of structural adjustment.

As for the process of restructuring, the government's position is expressed by the following statement: "the market will put everything in its place by itself." With such a position towards structural restructuring, it is not surprising that at that time there

was no place for the words quality, competitiveness, import substitution in the national economic policy.

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

A world-renowned quality specialist E. Deming, who at one time was a scientific advisor to the Japanese government and led Japan out of the economic crisis, in his book "Out of the Crisis" says: "... the management of paper money, and not a long-term digital strategy production - the way into the abyss. "

Regarding whether the state needs to pursue industrial policy, one can cite the statement of the outstanding economist of the past, Adam Smith, who 200 years ago laid the foundations for the scientific analysis of the market economy. About the role of the state, he said: "... only it can, in the interests of the nation, limit the greed of monopolists, adventurism, bankers and the egoism of merchants." It's like today about us and about our situation in the economy.

What are the results of economic activity today, what are the achievements in this area? Growth of gold and foreign exchange reserves, decrease in inflation, budget surplus and other financial and economic achievements. Is this the end result of public administration? And not the quantity and quality of goods and services sold in the domestic and foreign markets, and not the population's ability to pay to purchase these goods and services? And, ultimately, not the quality of life of the country's population ???

Therefore, it is quite natural that today the task is posed for all levels of the executive and legislative authorities - to improve the quality of life of Russian citizens.

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