SOI: 1.1/TAS DOI: 10.15863/TAS
International Scientific Journal
Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2025 **Issue:** 03 **Volume:** 143

Received: 11.03.2025
Accepted/Published: 30.03.2025 https://T-Science.org

Issue Article

Yulia Igorevna Prokhorova
Institute of Service and Entrepreneurship (branch) of DSTU
bachelor

Artur Aleksandrovich Blagorodov
Institute of Service and Entrepreneurship (branch) of DSTU
postgraduate student

Vladimir Timofeevich Prokhorov
Institute of Service and Entrepreneurship (branch) of DSTU
Doctor of Technical Sciences, Professor

Svetlana Yurievna Korablina
LLC TsPOSN «Ortomoda»
Ph.D., deputy Director

Galina Yurievna Volkova
LLC TsPOSN «Ortomoda»
Doctor of Economics, Professor
Moscow, Russia

ON THE POSSIBILITIES OF VARIOUS ASPECTS OF QUALITY TO ENSURE THE PRODUCTION OF IN-DEMAND PRODUCTS

Abstract: *the article presents the basic concepts of quality assurance with specific application functions: quality of the management system, product requirements, product design, design documentation, procurement, production and maintenance, measurements and monitoring, objectives and tasks. Systems and a systematic approach to quality assurance are given and substantiated. The purpose of international standards ISO 9000 series is studied. Their trends in improvement and development are shown. The role of control in quality assurance is outlined. regions of the Southern and North Caucasian Federal Districts on filling their markets with popular and competitive products. The results of such studies confirmed the validity of the understanding that the head of an enterprise vested with authority should not consider these criteria as unacceptable, but a measure of responsibility to his team for the results of the activities of this very team.*

Key words: *leader, competencies, responsibility, harmony, demand, personality, quality, professionalism, criteria and quality assessments, consumers, producers, independence, dedication, autonomy, profitability, quality, demand, competitiveness, market, profit, demand, buyer, financial stability, sustainable TEP, priority, assortment, assortment policy, implementation, paradigm, economic policy.*

Language: *English*

Citation: Prokhorova, Yu.I., Blagorodov, A.A., Prokhorov, V.T., Korablina, S.Yu., & Volkova, G.Yu. (2025). On the possibilities of various aspects of quality to ensure the production of in-demand products. *ISJ Theoretical & Applied Science, 03 (143),* 163-189.

Soi: https://s-o-i.org/1.1/TAS-03-143-14 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2025.03.143.14

Scopus ASCC: *2000.*

Introduction

UDC 658.56:075.83.

In small businesses, there are different ways to implement quality management systems.

This message contains one of the possible examples of implementation of such a system in a small enterprise. The approach to implementation of the QMS presented in the article includes the following three stages:

- review of the state of affairs in the organization;
- implementation of a quality management system;
- improving the quality management system.

These stages include several steps, including the following: Review of the state of affairs in the organization:

Step 1. Study the main components of your business, i.e. the main production processes that exist in it, and make a list of them.

*Step 2.*With this list in mind, decide whether any of the exceptions apply to your business (see ISO 9001:2000, 1.2). Remember that you will then be required to justify any exceptions in the Quality Manual. Putting the Quality Management System into Operation

*Step 3.*Identify the workers involved in the system and outline their responsibilities in writing.

Step 4. Align these responsibilities and the sequence in which they are performed with the list of key business components adopted earlier.

*Step 5.*Establish intersections between standards and core business components.

*Step 6.*Apply the standard and introduce a quality management system.

*Step 7.*Ensure that the quality management system is simple and functional, i.e. relevant to the functions of your business.

*Step 8.*Study the information coming through the feedback channels from the quality management system to improve its ideology and functioning. Improve quality management systems.

*Step 9.*Monitor and measure the results of the changes you've made to see what benefits they've brought! Review the state of affairs in the organization.

Now we know that you need to analyze your business and determine whether it can function more efficiently. Where should you start? The main stages and the work steps included in them have already been defined above. Now let's look at them in more detail.

Step 1: Research what the key components of your business are and prepare a list of them

You and your business partners, if any, should discuss and briefly document what the main components of your business are. Depending on the industry you are in, these components may differ. Below are some examples. Manufacturing:

- If you are a manufacturer, you may have one or more product names in your production;
- you can act as a wholesale warehouse and product distribution agent. Warehouse/product distributor/agent:
- you may deal with one or many types of goods;
- you can purchase components, select and package them, or assemble them according to customer requirements;
- you may provide information on the use of goods or, as a supplier of raw materials and supplies, also provide consulting services.

Wholesale trade/wholesale warehouse:

- you can purchase or store products from other manufacturers;
- *you can* deal with perishable products that must be constantly monitored and regularly updated;
- you can distribute and transport goods.

Agency for repair and after-sales service of products:

- you can serve several types of products, but it is important to remember that service may vary from customer to customer;
- you can supply equipment and parts for it and actually participate in its service.

Professional consultations:

you can carry out search research on customer orders;

- you can develop project concepts and plans;
- you can manage projects and provide consultations on the progress of the project throughout its entire life cycle.

In all of the above areas of production and service provision, it is possible to subcontract or employ workers from subcontractors. These needs should be identified and listed for each component of your business, as the standard requires that you manage the activities of subcontractors and suppliers.

In the future, when developing a quality management system, it is necessary to establish situations concerning the management of suppliers of materials and components.

Step 2: You are now ready to apply the ISO 9001 standard.

Review the list of key components of your business that you have compiled.

Are there any actions that require design work?

Designing involves turning some ideas or concepts into a plan or design for a product or service that meets customer requirements. This is done through drawing, computer modeling or academic research.

If design is necessary, then you should use clause 7.3 of the ISO 9001:2000 standard. If it is not necessary, and the production of products or provision of services is carried out according to previously developed and verified standards and specifications, then clause 7.3 can be declared an “exception” in accordance with clause 1.2 of the standard.

Are there any other actions listed in Section 7 of the standard that are not performed in your organization? These may also be included in the exclusions under 1.2. Remember that nothing you exclude should have a negative impact on the quality of your products or services. All such exclusions should also be justified in your Quality Manual (Section 4.2.2). Commissioning of the quality management system.

To move on to the next step, you need to commit to memory the list of key components of your business that you have previously thought out. At this stage, it may be useful to visualize each component in the list as a route map. Hang these maps on the wall in your office or at home and study them regularly to remember which processes you are creating a quality management system for. The usefulness of this representation of your business is due to the fact that you can now:

- identify the different elements of production processes and decide whether they all fit together well or whether something needs to be changed to make the whole process function better;
- identify the requirements of the standard that apply to the components of your business.

For the service industry. Before attempting this work, you should stop, think, and answer the following questions: “What is my product or service? What services am I actually providing?” For example, does my job include any of the following areas:

- consulting on legal matters;
- real estate consulting;
- training or preparation of personnel;
- posting information in the media;
- graphic design;
- design of special electronic equipment
- conducting individual consultations with specialists?

It is important to remember that the ideology of quality management systems does not seek to limit academic research, intellectual and creative activity within the core components of your business. On the contrary, this ideology aims to create structures and schemes within which your business should operate, ensuring that all activities within it are well understood and repeatable. This will allow you to deliver products and services of the required quality to your customers whenever they are needed.

Step 3: Involve people in describing the content of the work they do

Now is the time for all employees to be involved in describing how they perform those parts of the organization's core business for which they are responsible, by specifying:

- who is responsible for the implementation and verification of certain actions;
- where these actions are performed;
- when they are to be performed;
- how they are performed.

Below are some important points to think about:

a) if the work is being performed by a trained salesperson or specialist, then perhaps it is worth simply stating what specialist is required to perform the work and what qualifications, rather than describing its content in detail. For example, stating that a graphic designer, a qualified welder, or a professional consultant on call is required;

b) if the work is performed by a temporary worker or if special requirements are imposed on it, a more detailed description of it may be required;

c) it may be necessary to establish a sequence of actions to be performed,

for example, you will have to specify:

- how to write a preliminary research report;
- how to create a file;
- where to start work;
- who supervises the execution of the work;
- how the work is carried out and checked;
- who makes the decision to complete the work;
- how is the delivery carried out;
- what action follows this work and who performs it;
- What should reports on completed work contain and who saves them?

If the organization already has detailed work instructions, then this task can be considered half solved. Do not rewrite existing documents, simply indicate the name and designation of the document so that its implementation can be monitored and subsequently referred to in other documentation related to the quality management system.

G) *the most important!* Make sure all written documents are simple!

Step 4: Match job descriptions with your business core components list (Step 1) After all employees have written or used previously written work instructions related to their assigned parts of the organization's activities, you as a manager should, with the help of another employee, check:

- what is written in the instructions;
- Are you satisfied with how they fit together?
- whether all discrepancies and contradictions existing in them have been eliminated.

By appointing someone to help you, you have effectively chosen a management representative or, if you are doing all this work yourself, you have assumed the functions of a management representative. In doing so, you have now fulfilled one of the fundamental requirements of the standard. By coordinating all of these documents, you receive guidance on solving the main tasks of the system, which is another requirement of the standard. You can refine the style of these documents in the spirit that seems most convenient to you and your employees. At the same time, it may be necessary to review and improve the methods for solving these tasks.

Step 5: Determine where your list of key components of your business intersects with the standard

You or your representative must compare the documents you have written with the standard and establish:

- whether the requirements of the standard have been met;
- your own process management requirements.

If you find that some provisions of the standard are not reflected in the documents, you should consider how your organization should implement certain requirements. You may need to supplement your own procedures to ensure that they meet the requirements of the standard. You may also need to develop some additional documents, but you should be careful to ensure that the requirement of the standard applies to your organization. You can use documents developed by third parties, such as dealer manuals, installation and maintenance instructions for equipment. There is no need to rewrite these documents to include them in your quality management system. All that is required is that you provide the necessary references to them in the process control procedures in your Manual.

Step 6. Implementation of the standard and quality management system

If you continue to involve other employees in the implementation of the quality management system, they will probably develop together with the system and receive the necessary initial data for this. Therefore, the quality management system should reflect the real state of affairs in the organization, and not lead to unnecessary paperwork. The following important points should be noted.

- Don't create unnecessary paperwork, reporting forms, etc. Study what is already being done in the organization and design your methods so that they reflect how a particular job is being done, rather than including your own wishes about how it should be done.
- Create new reporting forms only when it comes to performing critical work. In many cases, the performer's signature on an existing form or a small addition to it is sufficient.
- Remember that reporting is necessary if:

a problem has arisen; a new, good offer has appeared; a consumer or employee has expressed a need for some action.

*Note.*If the organization is owned by several partners, such reporting may simply be work diaries that are regularly reviewed by all partners. They can then discuss situations that arise and agree on the necessary actions.

- To implement a quality management system, it is necessary that all employees have access to the documentation that applies to their activities. They must have an understanding of how the system works and how, for example, the adopted document control methods ensure that employees always have the latest versions of the documents that apply to the work they do and that they make decisions based on information that is relevant at that time.
- All employees must be trained to be able to independently maintain the quality management system in a state that meets current requirements when changes occur in the areas for which they are responsible. Each of them must know the procedure for introducing changes to the quality management system and how to report problems and make suggestions for improving the system. Remember that any changes must be agreed and approved by you before they are introduced.

Step 7: Make sure your quality management system is simple, functional, and meets your business needs

The following points are worth noting.

- The purpose of implementing a quality management system is to ensure control over the organization's activities and that all its employees responsible for performing certain actions know and understand their role and responsibility.
- The documentation that exists in the quality management system must always be ready for use. It is a source of information about how, when, where and sometimes why certain work or actions should be performed. For this reason, the documents should be simple in form and written in ordinary, colloquial language.
- The documentation must be in a form that allows its direct application in the organization. For example:

If the organization has computers, the system should be computerized rather than paper-based; if there may be language or other differences between employees in the workplace, graphic or multilingual forms of documents should be used.

- Documentation should reflect the current state of affairs in the organization. During audits, auditors will ask questions and require evidence regarding the extent to which personnel are familiar with the quality management system and use it. Documentation provides objective evidence of this.

Improving the quality management system

An effective quality management system has feedback loops that are aimed at improving the state of affairs in the organization, which in turn leads to an increase in the quality of its products and services.

Step 8. Consider information feedback in the quality management system as a means of improving the ideology and daily activities of the organization

Many small businesses do not feel they can undertake large-scale quality improvement programs. In fact, you have the ability to take appropriate actions at the right time and in your own way.

By noting areas that need attention while implementing corrective actions (Step 6), you will gain data and identify trends that are worth studying and should be taken into account when improving the organization.

Improvements may be simple and easy to achieve at first, but they become more significant as obvious opportunities for improvement are exhausted. However, persistence in systematic quality improvement is worthwhile because it promises significant benefits.

Improvements are usually implemented when the necessary funds and resources are available. A realistic approach to this issue and continuous progress instill confidence and generate enthusiasm.

Step 9: Monitor the changes and measure the results so you know what you have achieved.

It is important not to forget about the need to evaluate your achievements. One possible way to do this is to take into account the mistakes made and their cost. This makes it possible to identify those areas where you can achieve cost savings.

Measurements can be made by recording the resources and time spent on performing certain activities or providing services. Such assessments should be made for all activities, even the simplest and most insignificant ones, that are selected for improvement, before and after the relevant work is completed. The requirements of ISO 9001:2000 should be applied in different combinations to achieve the organization's quality objectives. However, it is sometimes useful to classify these requirements according to their applicability to certain aspects of the organization's activities. This will allow you to determine the sequence in which you wish to implement certain requirements.

Main part

Quality is a complex, multi-aspect and at the same time universal category of an object. Depending on the purposes of use and purpose, the following aspects of quality can be noted: philosophical, social, technical and economic, legal or juridical. The concept of "quality" from a philosophical standpoint has been developing for a long time, over thousands of years. At present, quality permeates almost all aspects of human activity at all levels of life: personal, social, state, global. For a clearer understanding of any concept, people try to express in verbal form the essence and properties of the described object. To describe the process of cognition of quality, Japanese corporations I. Nonaka and H. Takochi used the process of "spiral of cognition" (Figure 1).

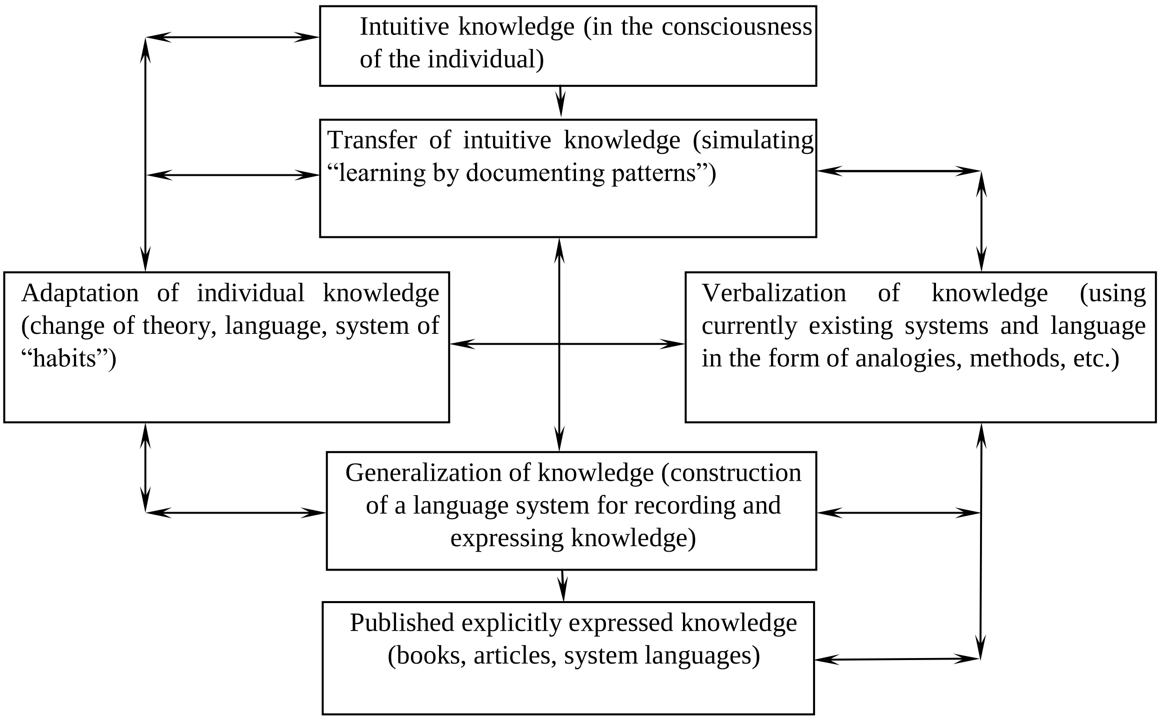

Figure 1. Spiral of knowledge creation and accumulation

From Figure 1 it is clear that knowledge arises from practical experience in the form of intuitive sensations and can be accumulated through collective work:

- through generalization, by describing intuitive sensations by analogy with other knowledge;
- through the generalization of diverse experiences and the search for patterns;
- through the development of languages, systems and theories for the precise and explicit expression of knowledge.

From a philosophical standpoint, quality means the essential certainty of the object under consideration, thanks to which it becomes specific and differs from another object.

The category of quality expresses the corresponding level of human cognition of objective reality. The first researcher of the category of "quality" is considered to be the Greek philosopher Aristotle (384-322 BC), who gave its definition. Aristotle considered quality in the following meanings: as a specific difference of an entity, a characteristic of the state of an entity, a property of a thing. Considering these meanings of the concept of "quality", Aristotle gives the following definitions in different works.

1. “Quality, on the one hand, is called a specific difference of essence, as, for example, a man is a certain qualitatively determined bipedal animal, and a horse is a quadruped; and a circle is a certain qualitatively determined figure, for it is a figure without angles, so that quality is a specific difference related to essence.”

2. “Quality is the state of entities in motion, such as heat and coldness, whiteness and blackness, heaviness and lightness, and other “definitions.”

3. "Similarity and dissimilarity are spoken of only in relation to qualities. One object is not similar to another, except insofar as it is given qualitatively determined. Therefore, the distinguishing feature of quality can be considered the circumstance that similarity and dissimilarity are spoken of only in relation to it."

From these definitions given by Aristotle, one can see the diversity, the multiplicity of differences between objects, i.e. the need, on the one hand, to qualitatively distinguish objects, and on the other, the possibility of combining them into species (typical) groups.

The concept of "quality" as "the state of entities in motion" given in the second definition has a fundamental, ideological significance. Subsequently, these views were implemented in the Shewhart-Deming cycle, and the subsequent development of methods, tools and quality management systems over the past centuries demonstrates the weight of this approach. In Chinese manuscripts of the first millennium AD, the hieroglyph "quality" consisted of two elements: balance and money, which scientists identify as "high-class", "expensive". On the other hand, the hieroglyph can be interpreted as the correspondence of the essence to the price of the product. Subsequently, philosophers of various schools turned to interpretations of this category:

mechanistic worldview (R. Descartes, J. Locke, T. Hobbes);

German classical philosophy (I. Kant, G. Hegel, L. Feuerbach);

Marxist materialistic direction (K. Marx, F. Engels, V. I. Lenin).

The German philosopher G. Hegel (19th century) gave the concept of quality a clear philosophical coloring: "Quality is, first of all, an immediate certainty identical with being. Quantity, on the contrary, is an external certainty to being, indifferent to it. Something ceases to be what it is when it loses its quality. The third stage of being, measure, is the unity of the first two, qualitative quantity."

Friedrich Engels believed that in nature and society there are not qualities, but things and phenomena that have qualities. That is, quality is inherent in an object and does not exist outside of it. K. Marx supplements the views of F. Engels with a proposal to consider a product socially useful, which has certain consumer properties and satisfies some social need: "The proposed product is not useful in itself. Its usefulness is established by the consumer." V. I. Lenin described the formation of the idea of quality through the process of cognition, by means of which an idea of an object is created in the consciousness of a person: "First impressions flash, then something stands out - then the concepts of quality ... (definitions of a thing or phenomenon) and quantity develop ... The most primary and most original is sensation, and in it, inevitably, quality ...". In Russian history and culture, the concept of quality was also considered, mainly through the prism of the qualitative side of the worldview, mentality, and soul of the Russian people. Qualitative manifestations in everyday life and interaction with other people were formulated by Vladimir Monomakh (1053-1125) in his book "Instruction". In this book, Vladimir Monomakh set out rules and instructions covering social, state and deeply personal problems. "Do not be lazy in your home, but watch everything. Beware of lies, drunkenness, and fornication, for from this the soul and body perish. Wherever you go on your lands, do not let the youths harm either their own or others', or villages, or crops, lest they begin to curse you. Wherever you go and where you stop, give drink and food to the poor, most of all honor the guest, wherever he comes from. Visit the sick, accompany the dead, for we are all mortal. Do not let a person pass without greeting him, say a kind word to him." With the beginning of book printing in Rus', the first documents describing various technologies and recipes appeared. They were first systematized in "Domostroy", a real encyclopedia of household management of that time. Its first edition was compiled in Novgorod at the end of the 15th-16th centuries - beginning of the 17th century. "Domostroy" consists of three parts: the first contains religious instructions, the second - instructions on family relations, and the third is devoted to proper housekeeping. Issues related to quality were raised in their works by Russian philosophers Vladimir Solovyov (1853–1900) “On Virtues”, Pyotr Struve (1870–1944), Maxim Gorky (1868–1936) “Half a Century for a Book”, Ilya

Mechnikov (1845–1916) “Science and Morality”, Vladimir Vernadsky (1863–1945) “The Tasks of Higher Education of Our Time” and “Philosophical Thoughts of a Naturalist”, Nikolai Berdyaev (1874–1948) “On Culture” and “The Spiritual State of the World”, Leo Tolstoy (1821–1910) “What is My Faith”, Fyodor Dostoevsky (1821–1881) “A Writer’s Diary”. More than others, issues of quality in the development of all aspects of Russian life: economy, politics, culture, education, upbringing,Russian philosopher Ivan Ilyin dedicated his professional activity to it. Ivan Ilyin believed that quality should become the national idea of Russia. “The Russian person has only one way out and one salvation – a return to quality and its culture, because quantitative paths have been traveled, suffered and exposed, and quantitative illusions are wearing out before our eyes to the end … We believe and know: the hour will come, and Russia will rise from decay and humiliation and begin an era of new prosperity and grandeur. But it will be reborn and flourish only after the Russian people understand that salvation must be sought in quality!” In the twentieth century, with the emergence and development of the concept of management and administration as a scientific direction, and subsequently as an independent direction of quality management and quality management, the number of different definitions of quality changed in content. Quality gurus (Deming, Juran, etc.) give their own definitions of this concept. Manufacturing enterprises also give their own definitions of quality. In the 70s, with the traditional approach to managing activities, the Ford Corporation adopted the following definition of quality:

"Quality is compliance with all necessary technical requirements, which are defined in working drawings, technical specifications and other similar documents." But already in the late 80s, with the development of relationships with consumers and, first of all, thanks to the success of Japanese companies, the Ford Corporation adopted another definition of quality: "Quality is determined by the buyer; the buyer wants products and services that, throughout their entire service life, satisfy his or her needs and expectations at a price that corresponds to the value."

During the last decades of the twentieth century, definitions of the term “quality” appeared, established in standards:- GOST 15467–79: “product quality is a set of properties that determine its suitability to satisfy certain needs in accordance with its intended purpose”;- ISO 8402–94: “quality is the totality of characteristics of an object that relate to its ability to satisfy stated and implied needs”;- ISO 9000:2000: "the degree to which a set of inherent characteristics fulfils requirements."

Table 1. Controversy over the concepts of "quality"

Author	Formulation of the concept of "Quality"
W. Shewhart	The difference between objects. Differentiation by the criterion "good - bad"
E. Deming	Quality – meeting the customer’s requirements not only to meet his expectations, but also to anticipate the direction of their future changes
K. Ishikawa	Quality has two aspects: objective physical characteristics. The subjective side is how good the thing is. Quality is the process of developing, designing, producing and servicing products that are most economical and useful and that accurately meet customer requirements.
F. Crosby	Quality – compliance with requirements
J. Juran	Suitability for use (fitness for purpose). Subjective side: quality is the degree of consumer satisfaction (to implement quality, the manufacturer must know the consumer's requirements and make its products such that they meet these requirements) Quality – fitness for purpose or application
A. Feigenbaum	The quality of a product or service can be defined as the totality of technical, technological and operational characteristics of a product or service, through which the product or service will meet the requirements of the consumer during their use. Quality is the total compliance of the characteristics of a product or service, including marketing, development, production and maintenance, as a result of which the use of the product/service will meet the expectations of the consumer.
J. Harrington	Quality is meeting the customer's expectations at a price he can afford when he needs it. High quality is exceeding the customer's expectations at a lower price than he expects.
G. Taguchi	Quality – the losses felt by society due to late delivery and inefficient use of products

The authors of the book "What is Quality?" in the 60s of the 20th century analyzed 232 literary sources, in which the concept of "quality" was defined in one way or another. In Russian literature alone, they identified more than 100 different formulations defining the concept of "product quality". From the entire variety of existing interpretations of the essence of the category "quality", the following elements can be identified, which include this concept:

- absolute assessment of an object, distinguishing this particular object from another;- an entity that is in motion (development);
- the possibility of considering this concept in relation to certain groups of objects;
- the possibility of expressing quality in quantitative assessments;
- the ability to satisfy not only existing but also future needs;
-fitness for purpose;
- price compliance;
- degree.

The technical aspect of quality is characterized by quantitative values of the object's indicators and its changes, which together give it a qualitative character. Unlike the philosophical aspect, technical quality indicators allow objectively comparing the characteristics of different objects and choosing better ones. The technical aspect of quality includes different types of objects: products, processes, activities, services. In this case, it does not matter whether the object is material or intellectual. The main purpose of technical aspect objects is a complete or partial replacement of production, human functions in order to facilitate their work and increase labor productivity. Technology, based on the knowledge of the laws of nature, significantly increases the efficiency of labor efforts. As production develops and new products are created, technology frees people from performing various productions, functions associated with both physical and mental labor. The technical aspect of quality is especially often used in standardization, when the designer assigns the tolerance value to a part, the closing link in the dimensional chain of the assembly element of the product. The smaller the tolerance, the less the risk of loss of performance or accuracy of products operating in dynamics. For example, a car engine, a bearing, a crankshaft, etc. According to its functional purpose, technology is divided into production and non-production (household). The most active part of technical means is production technology: machines, mechanisms, tools, equipment for controlling machines and technological processes, etc. Among the technical means of modern production, the most important role belongs to energy technology, which serves to obtain and convert energy. At present, the most important achievements of technology are the result of fundamental scientific discoveries. It is no longer possible to create mechanical means like nuclear reactors, lasers, computers, etc. purely empirically. A preliminary condition for their creation is a deep study and understanding of physical, chemical and other phenomena and processes. The main indicators of objects are their productivity, reliability and efficiency, which can be increased as a result of modernization or improvement. The implementation of a technical process depends mainly on the degree of equipment of industry, construction, agriculture, and transport with the most advanced means of mechanization and automation of production. The most intensively developing is the production of technical means that ensure the technical re-equipment of leading industries. Very important in production is the use of technical conditions, that is, documentation included in the set of technical documentation for industrial products, which specifies a set of technical requirements for the product, acceptance and delivery rules, control methods, and operating conditions. The development of technology depends on the system of social production. The pace of technical progress is determined by socio-economic factors, the correspondence of production relations to the level of development of production forces, in which technology is the most mobile element. Thus, technical aspects of quality are inevitably intertwined with other aspects of quality in the process of human activity.

The economic aspect of quality characterizes the cost of an object. At the same time, the consumer assessment of quality is decided in a constructive confrontation between the economic and technical aspects of quality. This contradiction, from a philosophical point of view, determines the inseparable unity between the economic and technical aspects of quality (one cannot exist without the other).

The special role of the connection between quality and economics is reflected in the science of "Labor Economics". Labor Economics studies the theoretical foundations and economic patterns that determine the most rational use of social labor at various levels (enterprise, industry, etc.), develops specific methods of scientifically based organization and planning of labor. The current problems of labor include the development of methods for the complete combination of material and moral incentives and enhancing their impact on increasing production efficiency, improving product quality, and economical use of material resources. Labor Economics is associated with a number of economic and technical sciences. Based on scientific and practical recommendations, labor economics develops a general methodological approach to solving issues of strategic and operational planning, labor accounting. At the same time, it relies on data from industry disciplines (industrial economics, etc.), widely uses materials on technical labor regulation to solve internal production problems, and covers a significant part of the issues of scientific organization of labor at enterprises. Economics connects the quality of labor (for example, products) with high-quality performance of work. The problems of production defects are inextricably linked with losses and costs of funds. Continuous reduction of defects in new products is the main factor in satisfying consumers. The social aspect of an object's quality is related to the subjective attitude of consumers to the object. This subjective view of quality depends on many factors, including not only the physiological characteristics of the subject, but also social ones: level of culture, income level, position in society, etc. The social aspect of quality explains the presence of a large number of product market segments to a much greater extent than other aspects. In recent years, the release of products has been accompanied by additional services that increase the value of products that are ready for sale. For example, a car ready for sale, the quality (or value) of which is determined by a set of its own characteristics, can be sold at a significantly higher price due to additional services: the presence of a car service station near the plant; a sales showroom where the manufactured products are demonstrated in the window; and also, taking into account the following: advertising of the manufactured car in all types of media or on the external dashboard; the brand of the enterprise; the image of the enterprise, etc. At the same time, the consumer grows, and his quality requirements do not so much increase as change in accordance with market requirements. More and more people are changing their labor activity from physical to mental labor. This shift occurs imperceptibly, but continuously. What the consumer liked yesterday, he no longer likes today. Fashion changes very quickly, including not only clothing, but also other items of labor. Soon, electronic presentation of cars will begin in the automobile markets, not by natural samples of a new car, but by means of multimedia display of their product from all angles, both outside and inside the cabin. Electronic demonstration allows consumers to get acquainted with the cars being developed much earlier. New products will be welcomed, and shortcomings will be quickly eliminated both in the design documentation and on natural samples of the car. Progress in electronics is so high that new products in electronic equipment replace each other almost every year. In addition, not only the standard of living changes, but also the way of life, which ultimately forces the manufacturer to catch up with consumer requirements. Such rapid progress is associated with changes in the management structures of organizations. Lagging behind market requirements very quickly leads one or another enterprise to a crisis state. The legal aspect is characterized by the normative reflection of quality in standards and regulations. That is, there is such a set of properties and quality indicators of an object, below which it is impossible to fall when manufacturing or using an object. New standards are developed in cases where the previous standard begins to slow down market demands for expanding sales volumes and consumer demands for product quality are not met. The name of the standard indicates its distribution: international standards (for example, ISO series 9000); European standards in use in the European Union; national standards in effect in their own country and, by agreement, in other countries; state standards developed in the USSR, but still valid today; Russian standards in effect in Russia. Any enterprise can issue its own internal standards, which are called organizational standards. They are valid both at its own enterprise and at supplier enterprises. Organization standards for products are divided into the following types: technical conditions, technical requirements, acceptance rules, labeling rules, storage rules, packaging rules, transportation rules, operating rules, etc. Each enterprise has the right to issue standards - estimated values of labor costs, material and monetary resources used in standardization, planning and management of production or an enterprise. Their violation is a non-conformity or defect. In the operation of products, restrictive rules are used as prohibitive measures: noise restrictions, odor restrictions, restrictions on the amount of CO in vehicle exhausts, etc. In order to improve ergonomics, for example, the location of the driver and passengers in the car, ergonomic rules are issued. All these restrictions on compliance with the relevant requirements ensure the quality of the product and eliminate possible risks of the product in operation. The theory of systems was first applied in the exact sciences and in technology. The application of systems theory in management in the late 1950s was the most important contribution of the management science school. In the development of quality assurance throughout the 20th century, the most important basic foundation was the systems approach. In the latest version of ISO 9000 series standards, one of the principles is the systems approach to managing the activities of an enterprise (organization). Let us consider the terms and definitions of the concept of "system". The dictionary of the Russian language gives the following interpretation of the term. A system is a set of elements that are in relationships and connections with each other and form a certain integrity, unity. The modern explanatory dictionary of the Russian language gives a translation from Greek and several different interpretations of this definition. System (from Greek) - a whole made up of parts, a connection. Dictionaries also give several more versions of this definition:

- a certain order based on the systematic arrangement and mutual connection of the parts of something;

- a device or structure that represents a unity of regularly arranged, mutually connected parts;

- a technical device that represents a set of interconnected structures, machines, and mechanisms that serve one purpose;

- a collection of any elements, units, parts, united by a common feature or purpose;

- a set of principles underlying any teaching, worldview, etc.;

- a set of methods, techniques, and rules for implementing something;

- classification, grouping;

- form, method, principle of arrangement, organization of production of something.

General management specialists give the following definition of a system. A system is a certain integrity consisting of interdependent parts, each of which makes its contribution to the characteristics of the whole. As can be seen from the above definitions, the concept of a system is quite multifaceted. In relation to the management of an organization's activities, the most preferable understanding is that of a system as interacting, interconnected parts (principles, rules, methods, etc.) that make up (create) a single integrity. Systems are divided into two main types: closed and open. A closed system has rigid fixed boundaries. Its actions are relatively independent of the environment surrounding the system.

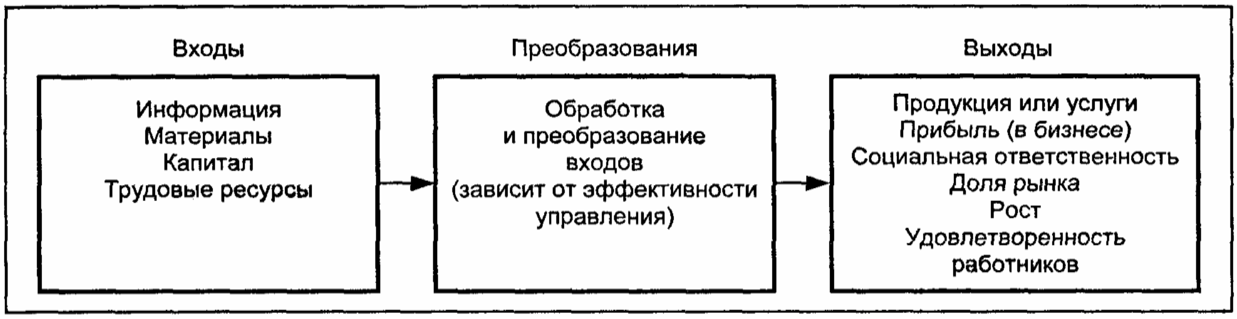

Figure 2. Example of an organization as an open system

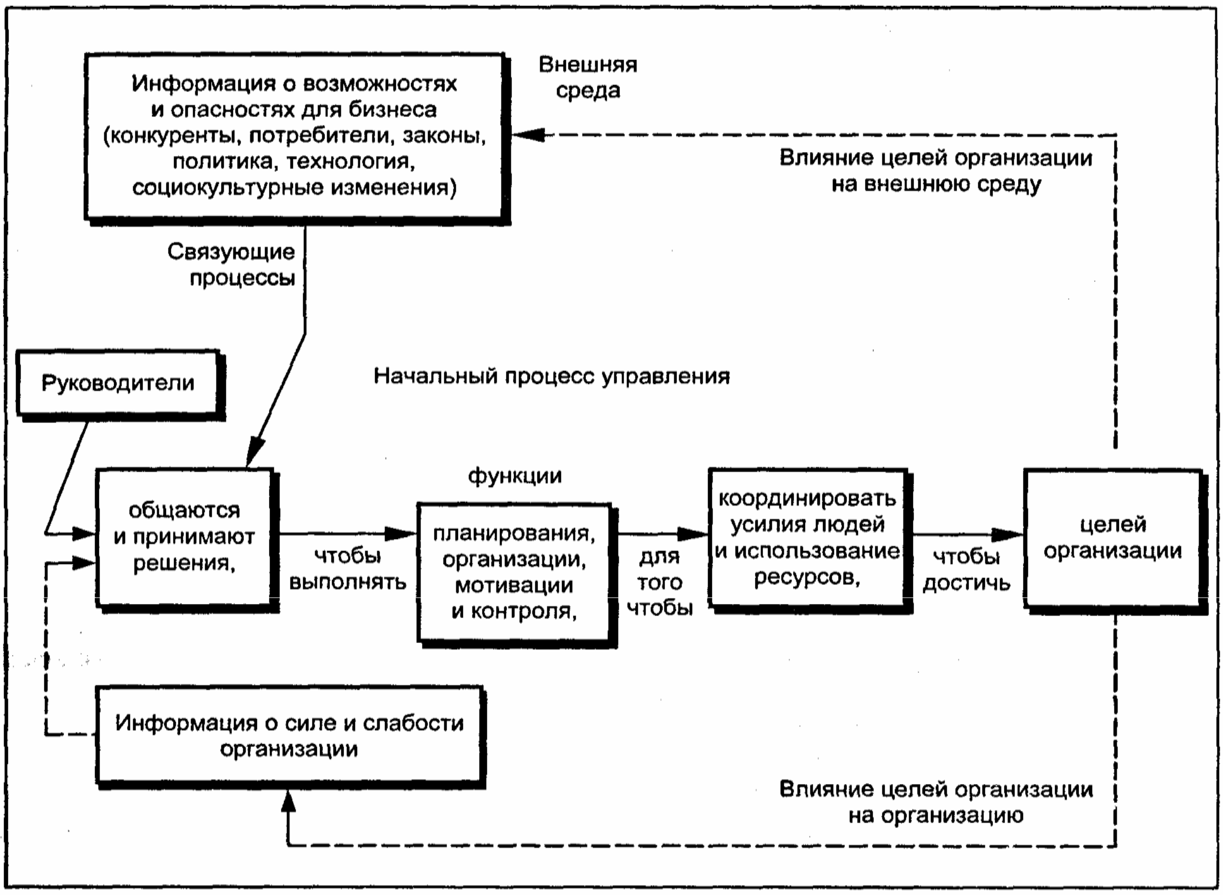

Figure 3. Management process in an open system

An open system is characterized by interaction with the external environment. Energy, information, materials are objects of exchange with the external environment through the permeable boundaries of the system. Such a system is not self-sufficient. It depends on objects coming from outside. In addition, an open system has the ability to adapt to changes in the external environment and must do so in order to continue its functioning. An example of an organization as an open system is shown in Figure 2. The organization receives information, materials, finances, and human resources from the environment. These components are inputs. In the process of transformation, the organization processes these inputs, transforming them into products and/or services. Products and/or services are the organization's outputs, which it transfers to the environment. How the management process is implemented in such a system is shown in Figure 3.

Systematic approach– a direction of research methodology based on the consideration of an object as a holistic set of elements in a set of relationships and connections between them, that is, the consideration of an object as a system. Speaking about a systems approach, we can talk about a certain way of organizing our actions, one that covers any kind of activity, identifying patterns and relationships for the purpose of their more effective use. The main principles of the systems approach:

Integrity, which allows us to consider the system simultaneously as a single whole and at the same time as a subsystem for higher levels.

Hierarchical structure, i.e. the presence of a set (at least two) of elements located on the basis of subordination of lower-level elements to higher-level elements. The implementation of this principle is clearly visible in the example of any specific organization. As is known, any organization is an interaction of two subsystems: the controlling and the controlled. One is subordinate to the other. Structuring, allowing to analyze the elements of the system and their interrelations within a specific organizational structure. As a rule, the process of functioning of the system is determined not so much by the properties of its individual elements as by the properties of the structure itself. Multiplicity, allowing to use a variety of cybernetic, economic and mathematical models to describe individual elements and the system as a whole. The systems approach is an approach in which any system (object) is considered as a set of interconnected elements (components) that has an output (goal), input (resources), connection with the external environment, feedback. This is the most complex approach. The systems approach is a form of application of the theory of knowledge and dialectics to the study of processes occurring in nature, society, thinking. Its essence consists in the implementation of the requirements of the general theory of systems, according to which each object in the process of its study should be considered as a large and complex system and at the same time as an element of a more general system. An expanded definition of the systems approach also includes the obligation to study and practically use the following eight of its aspects:

1) system-element or system-complex, consisting in identifying the elements that make up a given system. In all social systems one can find material components (means of production and consumer goods), processes (economic, social, political, spiritual, etc.) and ideas, scientifically conscious interests of people and their communities;

2) systemic-structural, which consists of identifying the internal connections and dependencies between the elements of a given system and allows one to gain an idea of the internal organization (structure) of the object being studied;

3) systemic-functional, which involves identifying the functions for which the corresponding objects were created and exist;

4) systemic-targeted, meaning the need for scientific determination of research objectives and their mutual coordination;

5) system-resource, which consists of carefully identifying the resources required to solve a particular problem;

6) system-integration, consisting of determining the totality of qualitative properties of the system that ensure its integrity and uniqueness;

7) systemic-communicative, meaning the need to identify external connections of a given object with others, that is, its connections with the environment;

8) systemic-historical, which allows us to determine the conditions in time of the emergence of the object under study, the stages it has gone through, its current state, as well as possible development prospects.

Almost all modern sciences are built on a systemic principle. Let's consider definitions and terms related to quality management systems. The following definition was given in the ISO 8402:1994 standard:

Quality system– a set of organizational structure, responsibilities, procedures, processes and resources that ensure the implementation of general quality management. ISO 9000:2005 defines a system, a management system and a quality management system. A system is a set of interrelated and interacting elements. A management system is a system that allows for the establishment of policies and goals, as well as the achievement of these goals. A quality management system is a management system that allows for the management and control of an organization with respect to quality. A. V. Glichev gives his own definition:

Product quality management system– is a way of organizing effective interaction between management and executive departments and individuals involved in the creation and manufacture of products, their sale, use and service maintenance in order to give them properties that ensure the satisfaction of specific consumer needs and demands with minimal expenditure of effort and resources. The given definition allows us to present quality management systems as systems of an organizational and technical type, characterized, at a minimum, by:

- clearly formulated goal (quality strategy, quality plan);
- composition, structure of specialized categories and governing bodies;
- the presence of direct and feedback links between these bodies (persons);
- a precisely defined contour (boundary) of the system's influence on product quality (throughout the entire life cycle, at individual stages, or in combination).

All of the above contains not only the constituent characteristics of the system, but also the principles of quality assurance:

- planning (both strategic and operational) of activities and their content aimed at creating products and/or services that meet the requirements of consumers and other interested parties;
- application of methods, technologies, and tools in the process of creating products and/or services of the required quality in their totality and interrelation;
- the interconnection of all elements of the management system, harmoniously organized and aimed at ensuring the required quality of products at all stages of the product life cycle.

In practical activities in organizing work in the field of quality, developing and developing quality management systems (and any other systems based on improving activities), the most preferable is the choice of the form of presentation of the system. In the field of scientific management and management of specialists, it is customary to display systems in the form of models. All existing models are divided into two main groups: material and abstract. Abstract models, in turn, are subdivided into:

- abstract research;
- abstract design;
- abstract-normative.

For research and practical purposes, quality system models are classified into three more groups:

- descriptive;
- graphic;
- mixed.

The most striking example of a descriptive model of a quality system is the 1974 Guidelines for the Development of Integrated Quality Management Systems at an Enterprise Based on Standardization, which contains a detailed verbal description of the QMS UKP model, and the ISO 9000 series of 1987 standards. The group of graphical models is quite numerous. Each of them displays the substantive essence of quality systems in a different form, with a different degree of detail and from different angles. The very first graphical model is considered to be E. Deming's diagram, which he himself described as follows: "This diagram, as I believe, is extremely easy to understand, and I have drawn it in the form of a "wheel" divided into four sectors. The wheel rolls along the line of "ideas concerning product quality" and "a sense of responsibility for product quality." It is very important that all four parts of the wheel are directly connected to each other without any beginning or end. It is for this reason that the developer drew a circle" (Figure 4).

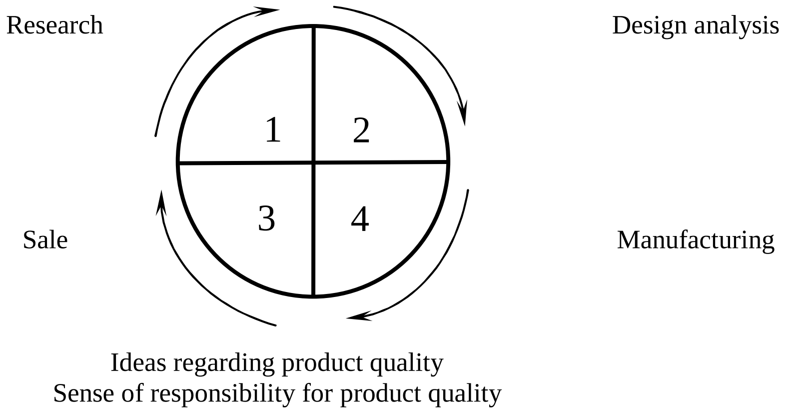

Figure 4. The first model of the quality system

In this model, ideas concerning quality imply planning of quality characteristics of products, activities for their implementation. Quality assurance is implemented throughout the entire continuous cycle of the product life cycle. This model presents all the main characteristics of quality management and quality assurance systems: planning of activities in the field of quality, interrelation of the main elements at all stages of the life cycle, ensuring the implementation of the planned. In the second half of the 60s, VNIIS developed and published in the journal "Standards and Quality" a basic diagram of product quality management (Figure 5).

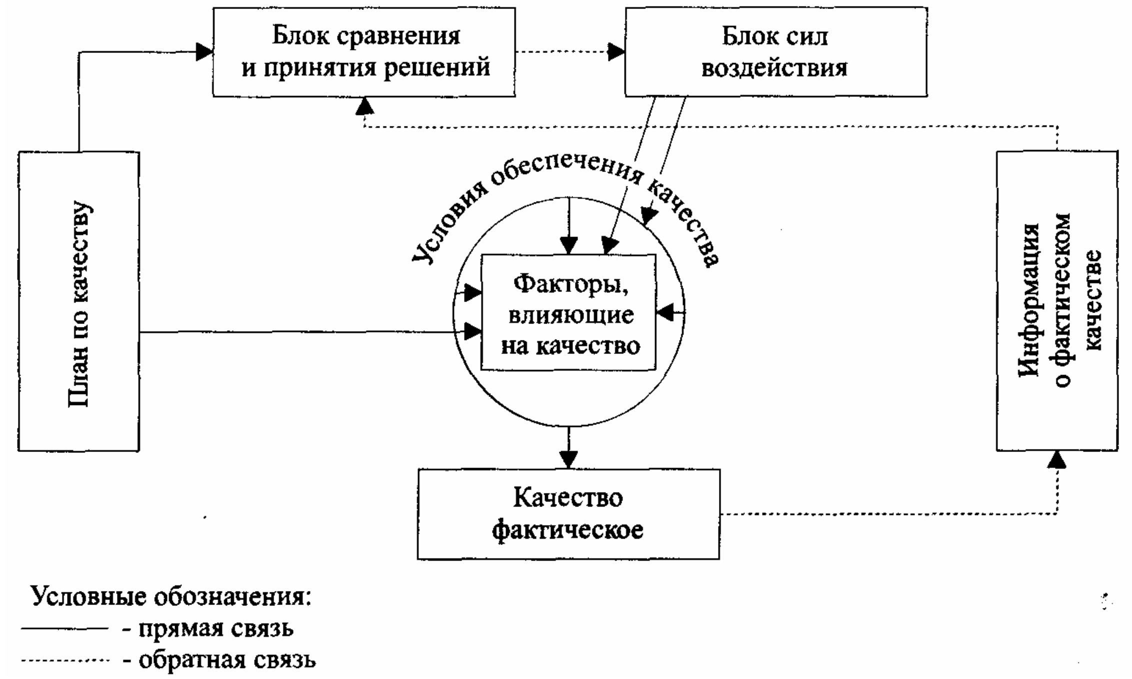

Figure 5. Product quality management mechanism

In developing the basic scheme of the quality management mechanism, all the countless forces influencing quality in this model were successfully combined into two classification groups:

1) factors affecting quality;

2) conditions for ensuring product quality.

The factors include:

- machines, equipment, other production equipment, i.e. means of labor;
- professional skills, knowledge, abilities, psychophysical health of workers, i.e. the ability of workers to perform effective and high-quality work;
- raw materials, materials, i.e. objects of labor.

The conditions for ensuring product quality include:

- the nature of the production process, its intensity, rhythm, duration;
- climatic conditions of the environment in production facilities;
- industrial interior and design;
- the nature of material and moral incentives;
- moral and psychological climate in the production team;
- forms of organization of information services and the level of equipment of workplaces;
- social and material living conditions of workers.

Despite the fact that all the listed forces affecting quality are divided into two separate groups, the function of provision also belongs to the first group. In this case, we are talking about the fact that in order to improve the quality of products, it is necessary to ensure the required level of factors. Among the first graphic models is the model of the Dutch specialists J. Etinger and J. Sittig, called the quality loop (Figure 6).

Figure 6. Quality Loop

The quality loop clearly demonstrates many stages that are consistently carried out in the process of creating, manufacturing, and using products. Identifying the stages of the life cycle from studying consumer demand and requirements to product disposal allows us to develop and manufacture products that best meet all established requirements. The quality plan is not clearly presented in the quality loop diagram. For this reason, when using the quality loop, it is necessary to make special additions and stipulate quality requirements. For example, in the recommendations for the application of ISO 9000 series standards of 1987, in the explanations regarding the quality loop, it is specifically stipulated: "By the nature of the impact on the stages of the quality loop, three directions can be distinguished in the quality system: quality assurance, quality management, quality improvement." Such an addition allows us to consider that the quality system has a quality plan. As graphic models of quality systems developed, the following two important provisions became increasingly visible in a methodological sense:

1) the need to highlight the differences in the methods of influencing quality during the creation, manufacture, and promotion of products to the consumer, i.e. as they sequentially move through the stages of the product life cycle;

2) determination of the relatedness, closeness, and commonality of the characteristic features of certain actions within the framework of quality systems, which allows for their classification and an approach to the formation of quality management functions.

In the early 1970s, the deepening of research in methodological areas resulted in the development of a three-dimensional axonometric model of the quality system (Figure 7). The model is built in a system of three coordinates: management levels, stages of the product life cycle and special functions of product quality management (the model was developed by A. V. Glichev, O. G. Lositsky, M. I. Kruglov, I. D. Kryzhanovsky, G. O. Rabinovich). The following special functions of product quality management were identified in this model:

1. Study and forecasting of needs, technical level and quality of products.
2. Planning for improving product quality.
3. Standardization of requirements for product quality.
4. Organization of product development.
5. Organization of technological preparation for production.
6. Organization of logistics.
7. Organization of metrological support.
8. Organization of staff training.
9. Encouraging quality assurance.
10. State supervision of compliance with standards.
11. Certification by quality categories.
12. Legal support for quality.

Quality management functions are called special because they must be distinguished from general production management functions. Within each special function, the following actions are consistently performed:

- establishing the purpose and objectives of this function;

- organization of the execution of this function;

- control over the effectiveness of the function's execution, i.e. over the progress of achieving the set goal;

- introduction of amendments, corrective actions and implementation in case of non-compliance.

The list and names of functions in all links of the model are preserved, but their specific content at all levels of management will be different.

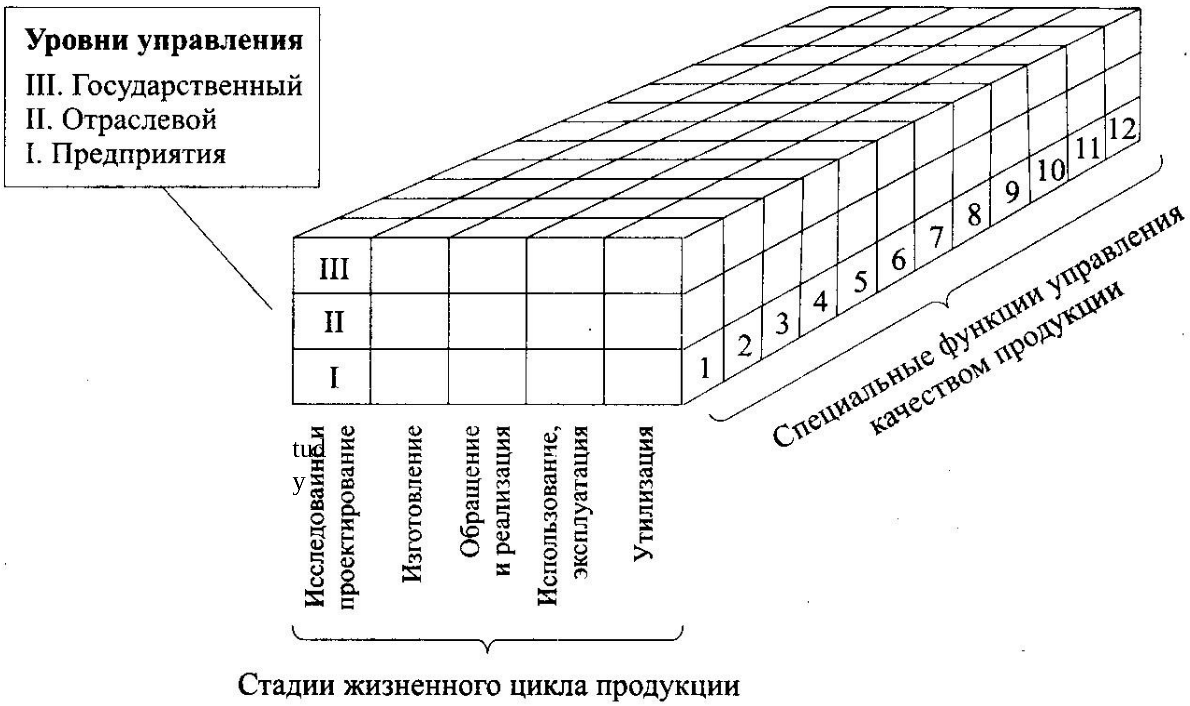

Figure 7. The first three-dimensional model of product quality management.

The considered models of quality systems have undoubted advantages, but they practically do not include the block representing the indicators of product quality (what the system is created for), as well as the blocks of the organization of the production and labor process (i.e. how actions are carried out to ensure the specified quality indicators). In 1974, VNIIS scientists M. I. Kruglov and I. D. Kryzhanovsky, using the example of a medium-sized machine-building enterprise, developed a flat graphic model of an integrated quality management system, including three contours (Figure 8):

- parametric;
- functional;
- organizational.

Parametric contour Reflects the following groups of product quality indicators: 301 - intended purpose; 302 - design; 303 - reliability; 304 - durability; 305 - maintainability; 306 - ergonomics; 307 - aesthetics; 308 - manufacturability; 309 - transportability; 310 - economy. The functional contour is detailed as follows: 401 - forecasting needs and product quality level; 402 - planning to improve product quality; 403 - product certification; 404 - development and launch of products into production; 405 - technological preparation of production; 406 - material and technical support; 407 - metrological support; 408 - selection, placement, education and training of personnel; 409 - ensuring a stable level of quality of manufactured products; 410 - organization of storage, transportation, operation and repair of finished products; 411 – stimulation of product quality improvement; 412 – departmental control of product quality; 413 – state supervision of compliance with standards; 414 – legal support for product quality management.

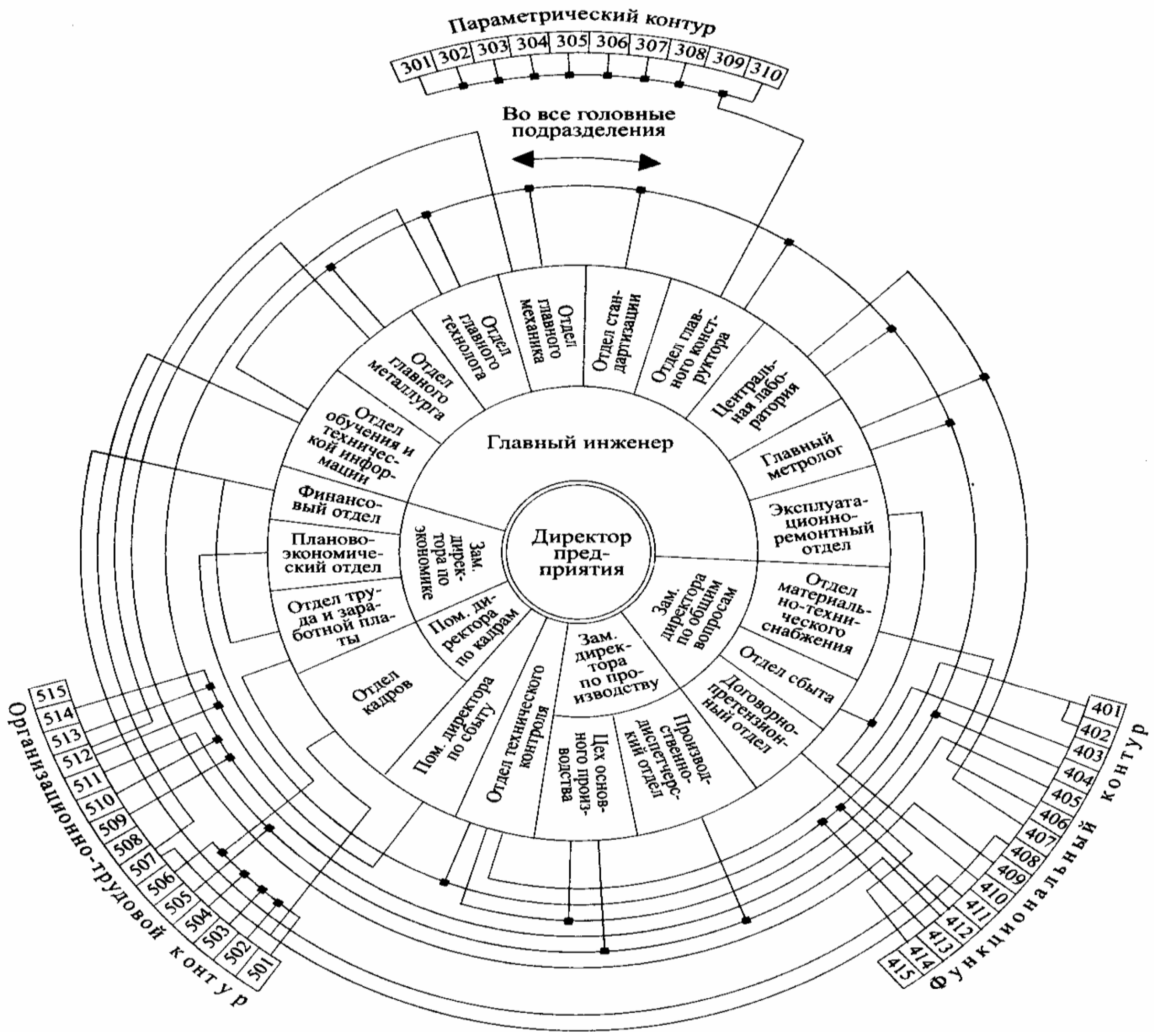

Figure 8. Model of the CS UKP for enterprises (associations)

The organizational and labor contour includes: 501 - forecasting relations in labor processes; 502 - planning the organization of labor; 503 - developing methods for measuring labor processes; 504 - assessing the quality of labor; 505 - organizing the division and cooperation of labor; 506 - organizing and regulating relations (subordination, coordination and discipline); 507 - organizing the selection, placement, education and training of personnel; 508 - organizing the study and dissemination of best practices; 509 - organizing and standardizing economic requirements; 510 - forming and standardizing requirements for the means of automation and mechanization of labor; 511 - organizing and maintaining workplaces; 512 - organizing human activity in the labor process; 513 - organizing the work schedule, meals and rest at work; 514 - organizing social relations outside working hours. This model has significant advantages over those considered earlier. Adding a parametric contour to the model reveals the goal-oriented, meaningful task of the "quality plan". The parametric contour reflects the requirements of state, industry standards and the requirements imposed by the customer, consumer on the quality of products. The parametric contour also includes the requirements specified in contracts or the organization's standards and technical conditions linked to them. The organizational and labor contour is also an important addition, which reflects the multifaceted work with personnel. Before the appearance of the model under consideration, it was not possible to reflect this side of quality activities in quality system models. The organizational and labor contour contains a set of enterprise standards for labor organization, activities of teams and individual employees. They provide the most appropriate forms of relationships in the production process, establish requirements for labor tools, social obligations of the administration and other conditions that ensure highly effective work of the personnel. It should be noted that in the current ISO 9000 series standards of the 2000 version, organizational and labor activities are not fully reflected. Figure 9 shows another quality system model – the technological triangle of A. Feigenbaum, linking various technologies with integrated quality management. American scientist and specialist A. Feigenbaum made an attempt to represent on a plane in interconnection systemic and technical responsibilities, structure and methods, areas of application, many areas of practical actions. This model allows to see in a clear graphic and verbal form many elements. From which systematized activity within the enterprise is formed, aimed at creating and manufacturing products in the interests of satisfying consumer demands. Another model of the quality management system (Figure 10), related to this group, was developed by Japanese professor Kaoru Ishikawa.The model clearly and in detail shows the influence of the marketing department on all the services of the enterprise that carry out quality management activities. In this scheme, Kaoru Ishikawa managed to reflect all the consistent activities in the field of quality management in the main structural divisions of the enterprise and correlate it with the product life cycle processes in which the enterprise participates. The model is a closed system with the measurement of performance indicators, analysis of the obtained data, and the establishment of feedback with the product life cycle processes. The world-famous management system based on the principles of continuous improvement, organized at the Toyota manufacturing enterprise, is even represented by two models: Toyota Way and the Toyota Production System. Toyota Way is a concept that includes a worldview and business methods. Toyota Way together with the Toyota Production System represent its “genetic code”. Toyota Way consists of two main components: continuous improvement and respect for people (Figure 11). Continuous improvement, often referred to as kaizen, defines Toyota's fundamental approach to doing business: question everything. Continuous improvement forces people to constantly learn and creates an environment that not only encourages change, but makes it natural and necessary. This is even more important than the specific improvements that are the merit of individual employees. Such an environment can only be created where people are respected, and this defines the second component of the Toyota Way. Respect for people is expressed in the company providing them with secure employment and encouraging each team member to strive to achieve higher results.

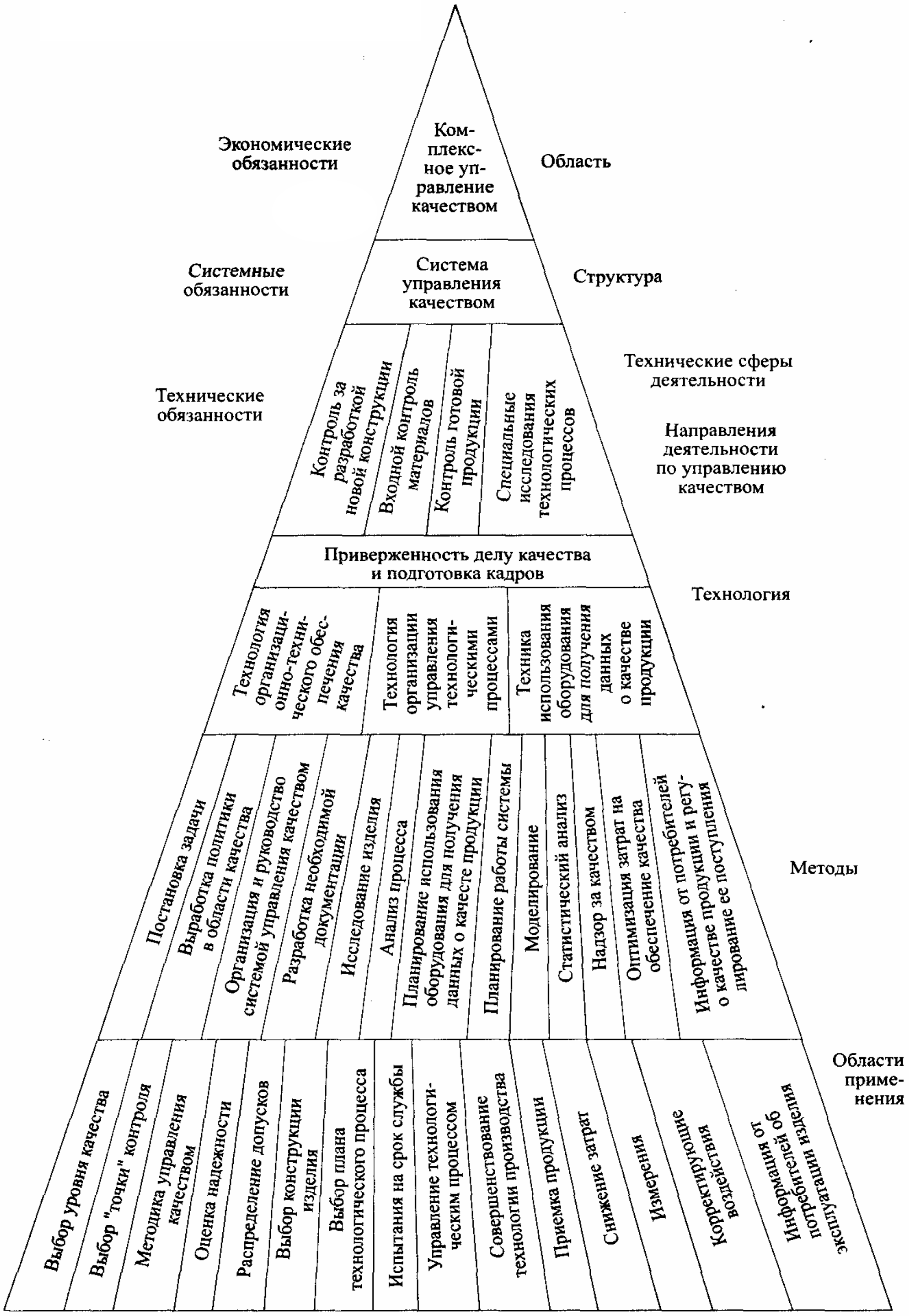

Figure 9. A. Feigenbaum's technological triangle

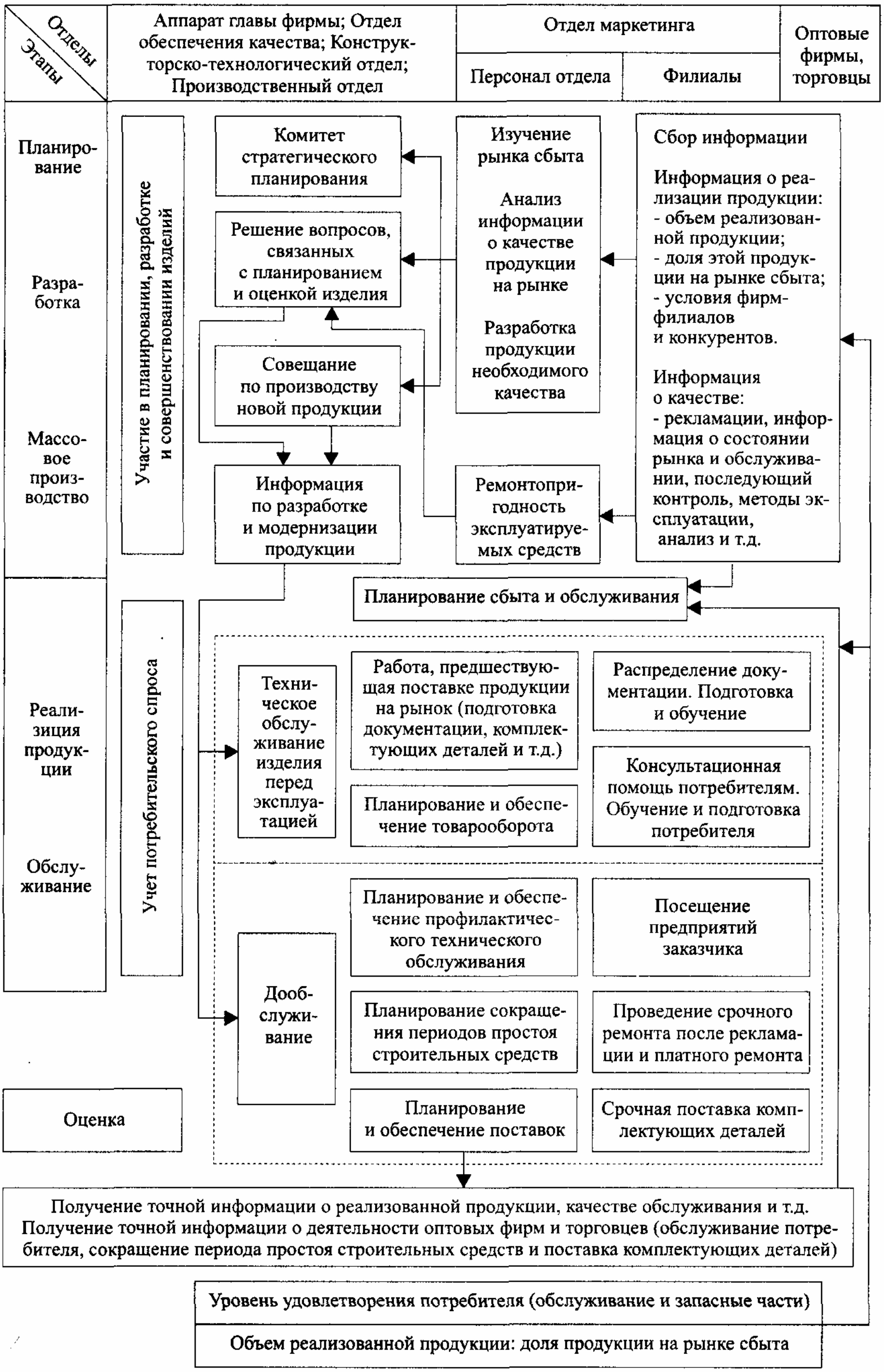

Figure 10. Kaoru Ishikawa's quality management system model

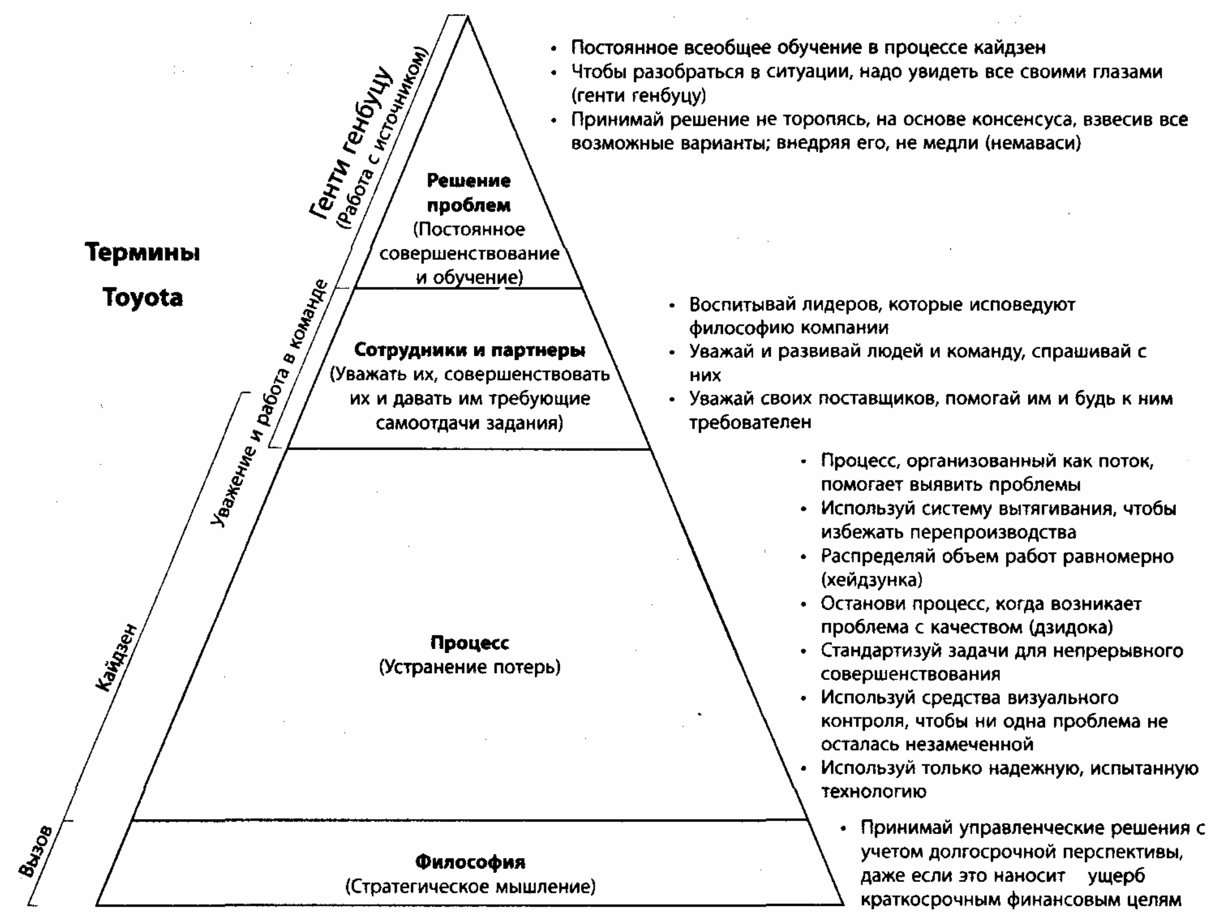

Figure 11. The Toyota Way of Life four-component model.

The Toyota Production System is represented as a house (Figure 12). The house is the entire structure. For the house to be strong and durable, the roof, the supports, and the foundation must be strong and durable. A weak link can destroy the entire system. There are different versions of this model, but the basic principles are the same. First, the goals: excellent quality, low costs, and the shortest possible lead time – that's the roof. Then come the two outer supports: just-in-time, which is the system's most well-known attribute, and jidoka, which aims to prevent defective parts from being passed on to the next stage of the process and to free people from machines, i.e. to provide automation with human intelligence. At the center of the system are people. And finally, the components that form the foundation: standardized, stable, and reliable processes, and heijunka, a production schedule that minimizes fluctuations in volume and assortment. A balanced heijunka schedule maintains system stability, helping to keep inventory to a minimum. Sudden increases in the production of one type of product due to the exclusion of other products from the range will lead to a shortage of parts or require the creation of significant inventories. The incredible stability of quality and the constant operational efficiency of the company are a direct result of the impeccability of production. Operational efficiency has become a strategic weapon of Toyota. In part, this level can be achieved by the tools and methods of quality improvement that have become widely known throughout the world thanks to Toyota. These are the Just-in-Time system, kaizen, the flow of single pieces, jidoka and heijunka, which gave rise to a real revolution in lean manufacturing. But the tools and technologies are not the weapons that can revolutionize business. Toyota's consistent success in applying these tools stems from a business philosophy based on an understanding of people and their motivation. The company's success is determined, above all, by the fact that, developing strategy, building relationships with suppliers and ensuring the existence of a learning organization, Toyota tirelessly improves leadership, teamwork and business culture.

Figure 12. Toyota Production System

Quality management systems will continue to develop on the basis of international standards, innovations, systems developed in various countries based on local specifics and the peculiarities of their development and mentality.

Conclusion

Remember, that small but constant changes aimed at improving the work of the organization, if well thought out and effective, can give advantages in the long term. The nine steps described above will help you to reap all the benefits that a quality management system will provide and will allow you to develop your business. The restoration and development of industry in the USSR in the 1930s led to the need to increase the scale of production, which set the industry the task of improving the methods of control of finished products, including the development and implementation of statistical control methods, special control charts and sampling methods at individual industrial enterprises. New requirements for product quality, especially for military purposes, led to the further development of individual elements of quality management and the introduction of more complex methods of ensuring it. In the post-war period, technical progress necessitated the development and release of high-quality products in a short time. This led to the creation of quality management techniques and the development of new methods for improving it. The first successful attempts to organize systematic work in industries in ensuring quality were made in the 1950s. The first systematic approach to product quality management in our country was introduced in 1955 at the Saratov Aviation Plant, where a “system for defect-free manufacturing of products (DFP) and their delivery to the quality control department and customers on first presentation” was developed (Table 2).

Table 2. Zero-Defect Manufacturing System

System name	Place of creation	The essence of the system	Control criterion	Control object	Scope of application
BIP (product manufacturing without defects)	1955 year Saratov	Strict implementation of technological operations	Single: compliance of the quality of work results with the requirements of the regulatory documents. Generalized: percentage of product delivery on first presentation	Quality of the performer's work. Quality of the team's work through the quality of the performers' work	Production

The introduction of the BIP was preceded by a control system in which workers, foremen, and managers of the enterprise were responsible for the implementation of the production program, and not for the quality of the products. Responsibility for the quality of the products was assigned to the Quality Control Department. Due to the high defect rate of the products, the Quality Control Department staff was unjustifiably expanding. The BIP system was a set of interrelated organizational, economic, and educational measures that created favorable conditions for the manufacture of products without defects in accordance with the requirements of the normative and technical documentation (NTD). It was based on the following principles:

– full responsibility of the direct contractor for the quality of the manufactured products,
– strict adherence to technological discipline,
– full quality control of products for their compliance with current documentation before presentation to the quality control service,
– concentration of technical control not only on the registration of defects, but also mainly on measures that eliminate the occurrence of various defects.

The introduction of the system contributed to the development of a new movement – work with a personal stamp. Such work was allowed to those performers who had been manufacturing products without defects for at least six months and had handed them over to the Quality Control Department on first presentation. The main feature and novelty of the BIP system was that it allowed for a quantitative assessment of the quality of work of each performer, teams of departments and, on this basis, for moral and material incentives. The assessment of the quality of work of individual performers was carried out on the basis of indicators of product delivery on first presentation:

$$P = \frac{A - B}{A} 100\% ,$$

where P is the percentage of quality control products accepted by the first presentation,

A– the sum of all presentations of products by the contractor to the Quality Control Department,

B– the sum of all deviations of the quality control product after the detection of the first defect.

The efficiency of this system was largely determined by the level of personnel training. Quality schools were organized to improve this level. The system attached great importance to the compliance of the equipment, tooling, instruments, measuring devices and technical documentation with the requirements of the technological process. Mandatory scientific organization of labor and production, clear intra-production links, rhythm of work on the release of high-quality products also contributed to the material and material incentives of the performer depending on the delivery of products on the first presentation. The quality management mechanism used in the BIP system influenced the management structure. Permanent quality committees were created at enterprises, the functions of the Quality Control Department changed, and quality days began to be held. The BIP system was the beginning of a comprehensive approach to the organization of work to improve product quality. The principles of this system have found application in many enterprises. During the implementation of the BIP system, its basic principles developed, changed and were enriched in relation to the specifics of a particular production.

The BIP system was recognized not only by our enterprises, but also by foreign companies, first by enterprises of the Federal Republic of Germany and the Polish People's Republic, and then by individual companies of the Federal Republic of Germany, the USA, Japan and other countries. However, the Saratov system, despite all its advantages, had a number of shortcomings. The system did not allow for monitoring and managing the level of development and design of the product, did not cover other stages of its life cycle - implementation and operation, it was distributed only to workers in the main production shops. In principle, the BIP was embodied in foreign "zero defects" programs and has been preserved in all domestic enterprises. In early 1960, a successful attempt was made at the Lvov Telegraph Equipment

Plant to implement the Saratov system of defect-free manufacturing of products, offering an equally relevant topic: the creation of a defect-free labor system (DLS) (Table 3).

Table 3. Zero-defect labor system

System name	Place of creation	The essence of the system	Control criterion	Control object	Scope of application
SBT (zero-defect labor system)	1961 year Lviv	High level of performance of operations by all employees	Single: Compliance of the quality of the work result with the established requirements. Generalized: Labor quality coefficient	Quality of an individual performer. Quality of the work of a team through the quality of individual performers	Any stage of the product life cycle

The purpose of the system is to ensure the release of products of excellent quality, high reliability and durability by increasing the responsibility and incentives for each employee of the enterprise and the production team for the results of their work. The main criterion characterizing the quality of work and determining the amount of material incentives is the labor quality coefficient, which is calculated for each employee of the enterprise, the team for a specified period of time (week, month, quarter) by taking into account the number and significance of production violations committed. The system establishes a classifier of the main types of production violations: each defect corresponds to a certain reduction coefficient. The maximum assessment of the quality of work and the maximum bonus are established for those employees and teams that did not have a single violation during the reporting period. The labor quality coefficient - both for individual performers and for the team as a whole - is calculated using the following formula:

$$K = Ki - \sum_{i=1}^{mc} Ksi$$

where Ki is the initial quality factor,

Ksi– the coefficient of reduction (c) of quality for failure to comply with the established indicator of work quality for the ith task, mc – the number of coefficients of reduction in quality.

At the same time

$Ksi = mi\ zi$,

where mi is the number of cases of poor performance of the same type of i-th task, zi is the standard reduction for poor performance of the i-th task.

The disadvantage of this method was that it only took into account the reduction coefficients, summing up the shortcomings for all indicators, and exceeding the established values of labor indicators did not affect the quality coefficient. The introduction of SBT allowed:

– to quantitatively assess the quality of work of each employee, each team,

– to increase the interest and responsibility of each employee and each team for the quality of their work,

– to improve the labor and production discipline of all employees of the enterprise,

– involve all employees of the enterprise in the competition for improving the quality of products,

– reduce losses from defects and complaints, increase labor productivity.

The Lviv SBT system, as well as the Saratov BIP system, were distributed mainly at the stage of production. It should be noted that both systems did not apply creative approaches to work and did not attempt to conduct scientific research to reduce production defects.

The KANARSPI system (quality, reliability, resource from the first products) was developed and first implemented at the engineering enterprises of the city of Gorky (Nizhny Novgorod) in 1957-1958. This system focused on increasing the reliability of products by improving the technical preparation of production, design bureaus and technologists, who accounted for up to 60-80% of defects detected during the operation of products. Pilot samples of units, parts, systems and products as a whole were created and their research tests were carried out. Pilot production, standardization and unification, general technical systems of standards, such as the Unified System of Design Documentation (ESKD) and the Unified System of Technological Preparation of Production (USTPP) (Table 4) were significantly developed.

Table 4. CANARSPI system

System name	Place of creation	The essence of the system	Control criterion	Control object	Scope of application
KANARSPI (quality, reliability, resource from the first products)	1958 year Bitter	High level of design and technological preparation of production	Compliance of the quality of the first products with the established requirements	Quality of the product and quality of the team	Design + technological preparation of production

A characteristic feature of the KANARSPI system is that it goes beyond the stage of product manufacturing and covers many types of work at the stages of research, design and operation. At the stage of research and design during the manufacture of a prototype, much attention is paid to identifying the causes of failures and eliminating them in the pre-production period. This task is solved by developing a research and experimental base, increasing the unification coefficient, widely using mock-up and modeling methods, accelerated testing, as well as design and technological development of products in the process of pre-production. The results of product operation are considered in the system as feedback and are used to improve the design of the product and the technology of its manufacture. In KANARSPI, as in previous systems, the principles of defect-free labor and defect-free production of products were widely used. The implementation of the KANARSPI system at enterprises in the Gorky Region made it possible to:

– reduce the time it takes to bring new products to a given quality level by 2–3 times,

– increase the reliability of manufactured products by 1.5–2 times and increase their service life by 2 times,

– reduce labor intensity and the cycle of assembly and installation works by 1.3–2 times.

At that time, the KANARSPI system actually revolutionized Soviet mechanical engineering. Planning for improving product quality and production management according to this criterion, 0, as well as spreading attention to quality throughout the entire life cycle of products were developed in the NORM system (scientific organization of labor to increase motor resources) (table 5).

Table 5. Scientific labor organization system for increasing motor resource

System name	Place of creation	The essence of the system	Control criterion	Control object	Scope of application
NORM (scientific organization of work to increase engine life)	1964 Yaroslavl	Improving the technical level and quality of the product	Compliance of the achieved level of engine service life with the planned value with step-by-step planning	Quality of the product and quality of the team's work	The entire life cycle of products

The NORM system was developed and first implemented at the Yaroslavl Motor Plant in 1963–1964. The purpose of the system is to increase the reliability and durability of manufactured engines. The NORM system was based on the principle of consistent and systematic monitoring of the engine life and its periodic increase by increasing the reliability and durability of parts and units that limit the engine life. The main indicator in the system is the engine life before the first major overhaul, expressed in engine hours. The growth of this indicator in the system was planned.

The organization of work in the system is built on the principle of cyclicity. Each new cycle for increasing the engine life begins after the previously planned level of engine life is achieved in production and provides for determining its actual level, identifying parts and units that limit the engine life, planning the optimal level of increasing the engine life, developing and checking engineering recommendations to ensure the planned level of engine life. The implementation of the NORM system allowed:

– increase the service life of Yaroslavl engines from 4 thousand hours to 10 thousand hours,

– increase the engine warranty period by 70%,

– reduce the need for spare parts by more than 20%.

Achieving the planned quality level became possible due to an integrated approach to product quality management by generalizing the experience of previous systems at all stages of the product life cycle. The experience of developing and implementing these systems in a number of cases remained the property of the developers themselves, was implemented very slowly and was not widely disseminated in industry. However, by the 1970s, the country's leadership understood the need for a wider and more effective implementation of the achievements of the best production teams in the practice of the entire domestic industry. In early 1970, specialists from the USSR State Standard, in cooperation with organizations from various ministries, analyzed, studied and generalized the advanced experience of enterprises in product quality management. The result of the research was the creation of unified principles for building an integrated product quality management system of an enterprise (IPQMS) based on its standards (Table 6).

Table 6. Integrated quality management system for enterprise products

System name	Place of creation	The essence of the system	Control criterion	Control object	Scope of application
KSUKP (integrated product quality management system)	1975 Lviv	Quality management based on standardization	Compliance of product quality with the highest achievements of science and technology	Quality of the product and quality of the team	The entire life cycle of products

The KSUKP is a set of measures, methods and tools used to purposefully establish, ensure and maintain the level of product quality corresponding to the needs of the national economy and the population at the main stages of the life cycle (planning, development, production, operation and consumption). Why is the system called comprehensive? Product quality depends on many factors and conditions: the degree of progressiveness of design developments, the quality of the raw materials, materials and components used; the perfection of planning and compliance with technological discipline; equipment of workshops and the flexibility of the incentive mechanism, rational selection and placement of personnel; organization of work of the entire team and the quality of work of individual performers. The complexity of the system is also manifested in the fact that it allows quality management at the main stages of the product life cycle: the stages of research, design and manufacturing, during circulation and sale, operation and consumption. The following tasks were solved during the functioning of the KSUKP:

– creation and development of new types of high-quality products that meet the best world standards,

– increasing the share of high-quality products in the total volume of production,

– improving the quality indicators of manufactured products and transferring them to a higher quality category,

– timely removal, replacement or modernization of products of the second category,

– systematic improvement of the quality of work of teams and performers,

– ensuring the release of products in strict accordance with the requirements of scientific and technical documentation, that is, the planned, specified level of quality.

Wide implementation of integrated systems at enterprises gave a powerful impetus to the development of factory standardization. Perfect highly developed industrial production sharply increased the number of functions of technical and economic services, expanded internal production links, increased the volume of information in the quality management system, which led to an increase in document flow, the need to streamline it, compliance of the documentary basis of quality management at enterprises and associations with a common normative-technical, regulatory and legal document. All these issues were resolved by using enterprise standards (STP) as an internal organizational-methodological, regulated and legal basis for the functioning of the quality management system. Enterprise standards performed an organizational and administrative function. They established the order, sequence of actions of management bodies and executors to achieve goals in the field of improving product quality. This allowed enterprises to influence all factors and conditions on which the quality of manufactured products depended, to plan and constantly ensure the implementation of plans to improve the technical level and quality of products. In 1975, integrated quality management systems (IQMS) were first introduced at leading enterprises of the Lviv region. The purpose of the KSUKP was to create products that meet the best world analogues and achievements of science and technology. In 1978, the State Standard developed and approved a system of basic functions for quality management of products. In connection with the introduction of KSUKP at enterprises, metrological support of production, multi-stage analysis of defects and statistical quality control were developed. Quality groups were created, quality programs began to be developed at enterprises and associations, product certification was introduced, a network of head and base organizations for improving the qualifications of specialists in the field of quality management was widely developed, courses on standardization and quality management were introduced into the training programs at universities. In 1978, the State Standard developed and approved the Basic Principles of the

Unified System of State Quality Management of Products (ESGUKP). In fact, this was a single state quality standard, which was a mandatory document for industrial enterprises throughout the country. The solution to the problems of improving the quality of manufactured products at many enterprises was linked to the system of efficient use of resources, the initiator of which was the Dnepropetrovsk region. The integrated system of the KS UKP absorbed new proposals and became known as the KSUKP and EIR (integrated system of quality management and efficient use of resources) (Table 7).

In the early 80s, using the provisions of the KSUKP, the teams of a number of enterprises in the Krasnodar Region, with the help of Gosstandart, developed and implemented a comprehensive system for improving production efficiency (KSPEP), which made it possible to move from a single-purpose product quality management system to solving a complex, multi-purpose task of managing production efficiency. As a result of the expansion, the complex systems received a new generalized name of KSUKP and EIR and KSPEP. In practice, this entire ramified complex of systems began to be called by its first name, KS UKP.

Table 7. Integrated system for managing product quality and efficient use of resources

System name	Place of creation	The essence of the system	Control criterion	Control object	Scope of application
KSUKP and EIR (integrated system for managing product quality and efficient use of resources). KSPEP (comprehensive system for improving production efficiency)	1980 Dnepropetrovsk, Krasnodar	Product quality and production efficiency management	Production efficiency achieved through improved quality	Product quality, economic indicators of the enterprise	The entire life cycle of products

For several decades, improving the quality of products at USSR enterprises was associated with the creation of quality management systems, but the current shift in this area in the country did not occur. The planned and administrative system of economic management that was in effect in the 1950s–1980s did not stimulate the process of creating high-quality products. This gave rise to the opinion that quality management systems, in particular complex systems, are not effective and should not be dealt with. There are serious reasons for this:

– monopoly in the production of many types of products, asserting the dictate of the producer,

– the primary responsibility of enterprises for the fulfillment of large planned production targets, which were most often achieved by reducing the quality of products,

– forced increase in production rates without adequate resources,

– a price formation mechanism that put enterprises developing and mastering new products at an economic disadvantage,

– Incentives for personnel based on performance were provided not based on the level of product quality, but on the fulfillment of the production volume plan.

When there is no goal to improve product quality, there is no need to look for a means to achieve it, especially if this threatens additional troubles. As a result, the creation of a quality management system at enterprises has turned into a purely political action of formal reporting of enterprises to ministries. During the transition to a market economy, directive management methods disappeared, competition between manufacturers appeared, who directly felt the requirements of the world community for product quality. The basis of quality management systems widely used in developed countries are the ISO 9000 series standards. The principles of the QMS UKP and ISO 9000 coincide, however, in its essence, the QMSUKP, being a product of the administrative system, had negative features such as indifference to the consumer, economic disinterest in ensuring quality. The main differences between quality systems according to ISO 9000 and QMSUKP are as follows, namely:

– focus on meeting consumer requirements,

– assigning responsibility for product quality to specific contractors,

– verification of the supplier's production by the consumer,

– selection of a supplier of components and materials,

– end-to-end quality control, from material to product disposal,

– organization of accounting and analysis of quality costs, etc.

At the same time, individual mechanisms of the KSUKP are still used not only at enterprises in Russia, but are also widely introduced into the practice of leading foreign companies as methods for improving product quality.

References:

1. Rebrin, Yu.I. (2024). *Quality Management: Textbook.* (p.174). Taganrog: Publishing house of TRTU.
2. (2024). *Efficiency and Quality Management. Modular program: Trans. from English* / edited by I. Prokopenko, K. North: in 2 parts, Part 1. (p.800). M.: Delo.
3. Feigenbaum, A. (2023). *Product quality control*. (p.471). Moscow: Economica.
4. Imai, M. (2024). *Gemba Kaizen: The Path to Cost Reduction and Quality Improvement*. / trans. from English. (p.346). Moscow: "Alpina Business Books".
5. Porter, M. (2023). *Competition / Translated from English.* (p.608). Moscow: Williams Publishing House.
6. (2024). *"What is Six Sigma? A Revolutionary Method of Quality Management"* / Pande P., Holp. / trans. from English - M.Zh. Alpinina, Business Books, 2024, 158 p.
7. Womack, J.P. (2024). Lean Manufacturing: How to Eliminate Waste and Make Your Company Prosper [Text] / James P. Womack, Daniel T. Jones / trans. from English, 2nd ed, (p.473). Moscow: "Alpina Business Books".
8. George, M.L. (2023). Lean Six Sigma: Combining the Quality of Six Sigma with the Speed of Lean [Text] / Michael L. George; trans. from English, (p.360). Moscow: "Alpina Business Books".
9. Shingo, S. (2023). *Fast Changeover: Revolutionary Technology for Optimizing Production [Text]*. (p.344). Moscow: "Alpina Business Books".
10. Vader, M. (2023). *Lean Manufacturing Tools: A Mini-Guide to Implementing Lean Manufacturing Methodologies* [Text] / M. Vader; trans. from English, (p.125). Moscow: Alpina Business Books.
11. Imai, M. (2024). Gemba Kaizen: The Path to Cost Reduction and Quality Improvement [Text] / Masaaki Imai; trans. from English. (p.346). Moscow: "Alpina Business Books".
12. Porter, M. (2024). *Competition: trans. from English.* (p.496). Moscow: Williams Publishing House.