



International Journal of Applied Business and Economic Research

ISSN: 0972-7302

available at <http://www.serialsjournal.com>

© Serials Publications Pvt. Ltd.

Volume 15 • Number 12 • 2017

Improving Quality Control Tools for Domestic Industrial Production

Elena V. Povorina¹, Olga V. Serbskaya², Natalia F. Bondaletova³, Elena V. Duplij⁴ and Natal'ya V. Buley⁵

^{1,5}Russian State Social University, Moscow, Russia

^{2,3}Plekhanov Russian University of Economics, Moscow, Russia

⁴Russian State Social University, Moscow, Russia. Email: DLA@rgsu.net

ABSTRACT

This study is devoted to the topical issue of analysis and improvement of quality control tools of Russian industrial enterprises. Improving the process of product quality control should be considered an important way to improve the overall efficiency. The effectiveness of management decisions taken at this stage depends largely on the success of production, economic and financial activity. Russian industries characterized by widespread obsolescence of fixed assets and inadequate human resource capacity have significantly fallen behind the developed countries in most industrial indicators. However, using the experience of the developed western nations and combining it with the accumulated experience of the Soviet era, Russia can still reach a new level in the field of quality management. This study examines the main approaches and quality control tools at a modern enterprise, and contains proposals for their improvement. The results presented in this article can be used for scientific purposes and in the work of the quality control units at industrial enterprises.

Keywords: Control, quality, industry, products, tools.

1. INTRODUCTION

In the modern Russian market conditions, quality management for domestic products comes to the fore.

In developed countries, quality management of a company is a focal point of all departments that have to do with the quality of the product or service provided. For better communication and, consequently, for better results, various approaches to quality management at enterprises are developed.

Product quality (including originality, technical level, the absence of defects in the performance, reliability in operation) is one of the most important means of competition, winning and retaining market

positions. Therefore the firm pays special attention to providing the highest quality products by establishing control at all stages of the production process, from the quality control used in raw materials and ending with the determination of conformity issued by the product specifications and parameters (not only in the course of its trials but also in operation). Therefore, product quality control has become a major part of the production process and it is not so much directed at identifying defects or defects in the finished product, but on checking the quality of the product during its manufacture.

The most important source of growth in production efficiency is constant improving of the technical level and quality of products. Technical systems are characterized by rigid functional integration of elements so there is no secondary element that may be poorly designed and manufactured.

All the above indicates the high relevance of the theme of the study for the improvement of quality control tools for domestic industrial production.

2. THEORETICAL ANALYSIS

Before proceeding directly to the study of quality of control instruments at an enterprise, the concepts of “quality”, “quality control”, “quality management”, etc. should be defined.

In this regard, quality is understood as a set of characteristics of the object relating to its ability to meet established and perceived needs.

Product quality is a set of properties that can be expressed quantitatively in quality indicators. The classification including ten indicators is generally accepted.

Applicability indices characterize the beneficial effects from the use of the product for its intended purpose and define the applicability area of the finished product.

Reliability indicators – reliability, maintainability, maintainability and durability of the product. Depending on the characteristics of the products being evaluated, all 4 and some of the above indicators can be used for the reliability characteristic.

Processability indicators characterize the effectiveness of design and technological solutions for providing high productivity in the manufacture and repair of products. Through processability, mass production can be achieved, as well as the rational distribution of materials, resources, labor, and time of technological preparation of production, manufacture and operation of the product.

Indicators of standardization and unification reflect how many standard, uniform and original component parts there are in a product. The fewer original parts a product contains, the better it is for the manufacturer and the consumer.

Ergonomic indicators reflect the human interaction with the product and with a set of hygienic, anthropometric, and physiological properties of a human, manifested in using the product.

Aesthetic indicators characterize the information expressiveness, rationality of form, the integrity of composition, and craftsmanship of products.

Transportability indicators reflect the suitability of products for transportation.

Patent and legal indicators characterize the patent purity of the product; they are a significant factor in determining competitiveness.

Environmental indicators can be absent in the product if the production is not environmentally dangerous, for example, TVs or CDs. This is the level of harmful environmental impacts that occur during operation or consumption of products.

Safety indicators characterize consumer and service staff safety – they ensure the safety of the installation, maintenance, repair, storage, transportation and consumption of products.

The aggregate of these indicators forms the quality of products. However, in addition to all these indicators, the price of the product is also important. That is the question of economically optimal quality. When a buyer acquires the product, he always considers if the price compensates for a set of properties it possesses. If the price for improving the quality is too high, then there will be no effectiveness in improving the quality itself.

Improving product quality is of great importance for the consumer, the manufacturer and the economy in general.

Manufacture of quality products helps to increase the sales and the profitability of capital as well as promotes the company's prestige. If the products are recognized for their quality, then it is not necessary for the company to spend additional amounts of money on advertising or design of expensive packaging to attract buyers.

Quality management means establishment and maintenance of the required quality level by means of systematic monitoring and purposeful influence on the conditions and factors, which affect the quality of products.

Constant improvement of product quality is possible only by means of systematic, integrated implementation of activities by the whole enterprise. It is traditionally believed that the main determinants of these conditions are:

- external factors (market requirements, policies and investments of the state, legal responsibility, the level of science and technology development, the quality of supplied materials, components, etc.);
- internal factors, which are classified in the following areas: technological (type of products, equipment, tools, control tools, quality of materials, documentation, etc.);
- social – so-called human factors (recruitment, training and development, relationships, recreation, etc.);
- economic factors (the relationship between product quality, cost and price; form of payment, bonuses for quality and penalties for defective goods; self-financing of units, etc.) (Filippova et. al., 2016);
- organizational factors (provision with materials and supplies, maintenance of equipment, dataware, regularity and rhythm of work).

One of the most important economic levers is planning of quality improvement for the products manufactured at the enterprises in line with the general guidelines on increasing the quality of industrial products in the following areas (Yakoreva, Biserovab & Demidova, 2007):

- development of new kinds of products using the latest scientific and technological achievements;
- manufacturing of new products including those manufactured under purchased foreign licenses as well as advanced products manufactured successfully by other enterprises;
- increase in the share of products that are superior in their technical and economic properties than the highest achievements of domestic and foreign science and technology in the total volume of products;
- constant improvement of the quality of products, their inclusion into higher category of products on the basis of improving the quality of production, the use of advanced technological processes and the use of effective materials.

Based on the developed plans of associations, internal planning of product quality improvement is carried out: specific tasks are set for improving the quality of products for each structural unit of the association, with an indication of the cost-effectiveness of carrying out activities, the timing of their implementation, and responsible executors.

When planning product quality, its certification plays an important role. Certification aims at ensuring the production of goods that according to their technical and economic indicators are of the highest, world level, meeting the needs of the national economy, the population of the country and exports (Bashkov & Silnov, 2015; Asyaeva, Chizhankova, Bondaletova & Makushkin, 2016).

Standardization is an important means of improving the quality of products. Standards enable to use material and labor resources more efficiently, in a timely manner to concentrate technical workers' and employees' attention on the use of additional production reserves.

The questions of the economic effectiveness of bonuses for the labor quality are an integral part of the general problem of increasing production efficiency. The economic encouragement of workers for improving the quality of labor is carried out depending on the economic efficiency received by the national economy from the use of labor of increased quality. An important lever of economic incentives to improve the quality of products are surcharges and discounts to wholesale prices, increase or decrease in deductions to the material incentive fund, depending on the fulfillment of the plan for the specific weight of products of the highest quality, deductions to the economic incentive funds from the additional profit received by the enterprise from the sale of products with a quality mark (Fedyukin, 2013).

In the management of product quality on a scientific basis, the organization of rational and effective control plays a special role.

Quality control is the verification of compliance of the product quality indicators with the established requirements, on the basis of which a decision is made to issue the product.

The economic effect of quality control is determined by the significant effect that can be achieved by eliminating or predicting the problems identified at all stages of product development. It is necessary to distinguish two basic forms of technical control existing in production – passive and active control.

With passive control, only compliance (or inconsistency) of various quality parameters of products with the requirements of regulatory documentation is established, on the basis of which the products are divided into suitable and unfit ones.

With active control, the results of the analysis are used to adjust the operation of the equipment in order to eliminate the causes of manufacturing poor-quality products. With this form of control, it is necessary that feedback be established, which makes it possible to actively influence the change in the production process.

To control product quality and to increase it, it is necessary to assess the quality level. The field of activity related to the quantitative evaluation of product quality is called qualimetry. Evaluation of product level and quality is the basis for developing the necessary control actions in the product quality management system. To assess the level of product quality, quality indicators are used.

The purpose of the assessment is to determine which quality indicators should be selected for consideration, by what methods, and with what precision their values are determined, what means will be required for this, how to process and in what form the evaluation results should be presented.

Quality control of products is established at all stages of the production process, beginning with quality control of the raw materials used, and ending with the determination of the compliance of released product with technical specifications and parameters, not only during its testing but also in operation. For complex types of equipment, quality control is also performed after installation of equipment at the customer's site (Mechikova & Novikov, 2015; Gureva, Kirillov, Vinichenko, Melnichuk & Melnychuk, 2016). This approach to control involves testing as soon as individual parts of the product are ready (especially for complex types of equipment). The strengthening of quality control is largely related to the focus on a specific consumer.

Thus, quality control is designed to ensure the verification of the implementation of management decisions at all levels of management to comply with the established standards and conditions of economic activity of the enterprise.

To ensure proper quality control it is necessary to have:

- indicators (standards, technical parameters) characterizing the quality of products;
- quality control methods and tools;
- technical means for testing;
- the results of complaint analysis;
- the causes of defects, and conditions for their elimination.

The control process should go through the following stages:

1. Definition of the concept of control (a comprehensive control system “Controlling” or frequent inspections);
2. Defining the purpose of control (decision on the appropriateness, correctness, regularity, effectiveness of the management process);
3. Planning of inspections:
 - objects of control (potentials, methods, results, indicators, etc.);
 - controlled standards (ethical, legal, production);

- subjects of control (internal or external control bodies);
 - control methods;
 - volume and means of control (full, continuous, selective, manual, automatic, computerized);
 - the timing and duration of the inspections, the sequence, methodologies and tolerances of inspections.
4. Determination of the values – actual and prescribed.
 5. Establishing the identity of discrepancies (detection, quantification).
 6. Determination of a solution, determination of its weight.
 7. Documenting the solution.
 8. MetaCheck (verification check).
 9. Communication of the solution (oral, written report).
 10. Evaluation of the solution (analysis of deviations, localization of causes, identification of liability, investigation of possible remedies, remedial measures) (Mechikova, 2011).

Types of control are distinguished by the following features:

1. Belonging of the subject of control to the enterprise:
 - internal;
 - external.
2. On the reasons for control:
 - voluntary;
 - according to law;
 - according to Charter.
3. On the object of control:
 - monitoring the processes;
 - control over decisions;
 - control over the objects;
 - monitoring the results.
4. Regularity:
 - systematic;
 - irregular;
 - special (Mechikova, 2011).

The following statistical methods relate to the seven major quality control tools (Figure 1)

- checklist;
- bar chart;
- scatter chart;
- Pareto chart;
- stratification ;
- Ishikawa diagram (cause-and-effect diagram);
- control chart.

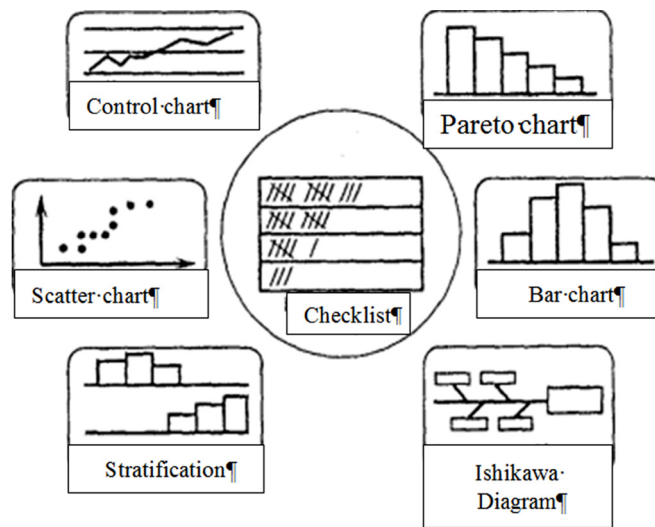


Figure 1: Quality Control Tools

1. The checklist (or sheet) is a tool for data collection and automatic ordering to facilitate the further use of the collected information.
2. A histogram is a tool that allows to visually assess the distribution of statistical data.
3. The scatter diagram is a tool that allows to determine the type and tightness of the relationship between pairs of relevant variables.

These two variables can refer to:

- the quality characteristics and the factor affecting them
- two different quality characteristics
- two factors affecting one quality characteristics

To reveal the connection between them, the scatter diagram is used, which is also called the correlation field.

4. Pareto Diagram is a tool that allows to distribute efforts to solve emerging problems and to identify the main reasons for starting to act.

5. Stratification or delamination is one of the most effective statistical methods widely used in the quality management systems.
6. Ishikawa Diagram (cause-and-effect diagram, “fish ridge”)

The result of quality management process depends on many factors, between which there are relationships such as cause – effect (result). The diagram of causes and effects is a means of expressing these relations in a simple and accessible form.

An example of the Ishikawa Diagram is shown in Figure 2.

This diagram is built to identify possible causes of consumer dissatisfaction.

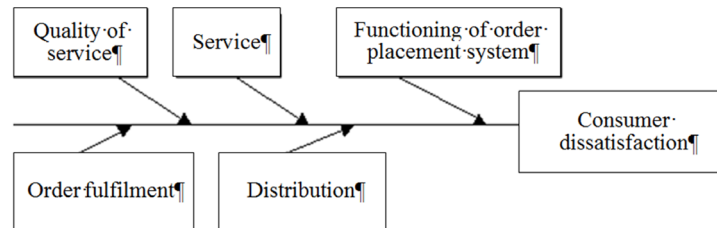


Figure 2: Example of Ishikawa diagram

7. Control charts is a tool that allows to monitor the progress of the process and act on it (with the help of appropriate feedback), preventing its deviations from the requirements imposed on the process.

The use of control charts has the following objectives:

- to keep under control the value of a certain characteristic;
- to check the stability of processes;
- to take immediate corrective measures;
- to check the effectiveness of the measures taken.

Thus, having studied the basic approaches to metrological instrumentation, methods and tools for monitoring and analyzing defects, it is necessary to proceed to the study and calculation of the costs of implementing quality management (Golovanova, Asyaeva, Gavrilenko, Temirkanova & Sokolov, 2016).

Control is only part of a system of management quality. At the same time, quality management cannot be carried out in the form of disparate and inconsistent operations; it requires a holistic system approach.

The Quality Management System (QMS) is a tool to achieve high quality of the enterprise management processes in order to obtain the specified final results, i.e. customer satisfaction with the quality of the product or service produced (Mechikova, 2011).

The concept of “quality” in a QMS is multifaceted. It includes the quality of economic calculations, technological equipment and production technology of the enterprise, environmental parameters, socio-psychological relations, ethical standards, legal relations, etc. At the same time, the quality of the final product is certainly the dominant. The main target of setting up the QMS, built on the basis of ISO 9000 standards, is to ensure the quality of the products required by the customer, and to provide them with

evidence of the enterprise's ability to do so. The main principle of the QMS is the principle of continuous improvement, without which the system quickly ceases to exist.

The main requirement to the QMS established in accordance with ISO 9001, reads: "Document what you do; do what was documented." If this requirement is violated, the quality management system will cease to function because the company will not be able to confirm the compliance of actual procedures with documented ones.

The requirements of the standard provide a common basis for establishing procedures, performance standards and indicators of customer satisfaction. In addition to providing a guarantee to the consumer, the QMS can be used for the following purposes:

- to provide an overall framework for coordination and communication between units;
- to improve the efficiency and effectiveness of processes;
- to define tasks and concentration of efforts on customer needs;
- to achieve and maintain the desired quality of products and services to meet the customer's stated needs;
- to create a base for improving the performance of both the individual employee and the enterprise as a whole.

The QMS implemented in the company according to ISO 9001 in one country, is comparable to the QMS based on the same standard in a different country. Such comparability brings indisputable benefits to businesses (Mechikova, 2015).

At present, many enterprises and organizations implement quality management systems according to ISO 9000 standards. After the introduction of the system, there is an interest in evaluating its effectiveness and efficiency. However, this task is a difficult one, due to the fact that the evaluation of effectiveness can be considered in relation to a product or service, process or system as a whole, as well as for the whole company or a structural unit, workplace or business process.

Effectiveness is the degree of implementation of the planned activity and achievement of the planned results.

Efficiency is the ratio between the result achieved and the resources used (Mechikova, 2015).

When solving the problem of assessing the QMS effectiveness and efficiency, questions arise, for example, along which criteria to evaluate the effectiveness and efficiency of an organization? How often is it necessary to evaluate the effectiveness and efficiency of the QMS?

The answers to these questions can not be unambiguous, because it depends on the size and type of activity of the organization.

Estimation of the QMS effectiveness can be carried out by various methods using statistical analysis, correlation-regression analysis, the method of expert opinions, etc.

The following is a methodology for assessing the effectiveness and efficiency of the QMS developed for enterprises of the military-industrial complex. However, it can be used at manufacturing enterprises

of other spheres of activity. This methodology establishes the criteria and procedures for assessing the effectiveness of the QMS. The results of the evaluation can be used in the analysis of QMS by management as part of input data for QMS analysis.

The main data used in the calculation are the results of the company's activities for the year, namely:

- summarized results of internal audits for the year;
- QCD reports on received consumer complaints about the products;
- indicators of the quality of products, contained in the reports on defects detected at the entrance control, with quality control in the production process, acceptance testing of the finished product;
- data of author's supervision of the process of use of products by customers;
- results of product tests;
- results of achievement of the objectives in the area of quality;
- supplier evaluation results;
- information on indicators of the quality of effectiveness and efficiency of processes.

Evaluation of the effectiveness and efficiency includes the following stages:

Stage 1 - assessment of performance of specific criteria of QMS effectiveness;

Stage 2 - assessment of specific performance criteria;

Stage 3 - assessment of the economic efficiency of the QMS;

Stage 4 - assessment of the effectiveness of the enterprise;

Stage 5 - interpretation of the effectiveness assessment and the effectiveness of the QMS of the enterprise.

Competitiveness of any organization, regardless of the form of its ownership and size, depends primarily on the quality of its products and the commensurability of the price of this product with the proposed quality, i.e. to what extent the products of the enterprise satisfy the needs of the consumer.

The quality of the products during the purchase is assumed and commensurate by the modern consumer with a known price of this product. This process of price and quality comparison is not easy for formalization; however, we often carry it out in ordinary stores simply on the basis of intuition and some ideas about the market. A more competent and formalized approach is implemented between organizations in the process of concluding supply contracts, when the requirements for products with explicit specification of quality requirements are included in various documents, for example, references to GOSTs, requirements for delivery, installation, maintenance, etc.

If, as a result of assessing the effectiveness and efficiency of the QMS, it was found that the quality management system at the enterprise is not effective enough and this is due to the inefficient implementation of the quality control function, then it is necessary to take appropriate measures to improve it.

Increasing the effectiveness of the QMS is possible through coordinated activities in three main areas:

- conducting procedures for standardization and certification in the enterprise;
- improvement of the organizational and human resources potential (improvement of the organizational structure of the enterprise, improvement of professional skills of the staff, etc.)
- updating of technical and technological support (improvement of technology, purchase of measuring equipment, application of information technologies).

The full and accurate use by the subjects of management and economic activity of existing international and state standards, metrological norms and certification rules creates the necessary prerequisites for:

- the protection of the region's interests and rights of people living in it for the use of products and quality services that are safe for the health of citizens and the environment;
- improving the competitiveness of products made in the region, and its promotion to the world market;
- rational use of the region's natural and industrial resources;
- the increase of production and economic potential of individual companies and the entire region.

In accordance with the current legislation of the Russian Federation, the main forms of control and confirmation of safety and quality of products are state supervision over compliance with mandatory standards requirements, state metrological supervision and control, as well as mandatory and voluntary forms of certification.

To control the safety of products and industries in foreign and domestic practice, certification is used. It is carried out directly by government agencies or under the supervision of public authorities. When assessing the quality, functional and other indicators of product quality, voluntary forms of certification are used, usually not controlled by government agencies or organizations.

The probability of appearance of defective products on the consumer and industrial markets of the region essentially depends on the quality of metrological subsystems of the supplier organizations, which together form the regional subsystem of metrological support.

The overall level of safety and quality of the products produced and consumed in the region can be substantially increased through the development, practical application and certification of quality systems of supplier organizations, controlling organizations, etc.

As is known, economic agents of various forms of ownership create, produce and supply products or services that have such a combination of properties and characteristics that give them the ability to satisfy the conditioned or perceived needs, demands, requirements of consumers (customers). This correlates with the definition of the concept of "quality" established by ISO 9001. Increasing competition in the world market leads to stricter requirements that the consumer and the customer impose on the quality of products and services. Usually, the requirements of consumers (customers) are established in technical specifications for product development and are implemented in standard documentation (technical specifications, enterprise standards) for serially produced products. However, in itself, this cannot be a reliable guarantee that the requirements of the consumer (customer) will really be satisfied, since the organizational and technical mechanisms (systems) of the developer or producer can have significant drawbacks (Mechikova, 2015).

At the top of the organization, the standard prescribes two goals:

- increase in customer satisfaction;
- constant improvement of the organization.

In the fundamental ISO 9000 standard, the following eight principles of quality management are identified, contributing to the achievement of quality objectives:

1. customer orientation – we all depend on our customers and therefore must understand the current and future needs of the customer, fulfill the customer's requirements and try to exceed his expectations;
2. leadership – leaders establish the unity of the goals, directions and internal environment of the organization. They create an environment in which people can become fully involved in achieving the organization's goals;
3. involvement – employees of all levels are at the heart of the organization, and their full involvement makes it possible to use their abilities for the benefit of the organization;
4. process approach – the desired result is achieved more effectively when the relevant resources and activities are managed as a process where each action is considered as the transformation of some input into a result using necessary and sufficient resources;
5. a systematic approach to management – identification, understanding and management of a system of interrelated processes for specified purposes, contributing to the effectiveness and efficiency of the organization;
6. continuous improvement is the permanent goal of the organization;
7. an approach to decision-making based on facts – effective decisions are based on measurements, logical and intuitive analysis of data and information;
8. mutually beneficial relations with suppliers – a mutually beneficial relationship between the organization and its suppliers increases the ability of both organizations to create value.

The improvement of qualification of personnel in the field of quality becomes an objectively necessary part of production activity and is no longer considered only as a desirable, optional form of this activity. The unwillingness of employees to improve their qualification is regarded as a violation of the production discipline with all the ensuing consequences.

Training of personnel in the field of quality should be in the center of attention of heads of the enterprise and its divisions. They perform systematic assessment of the compliance of knowledge and skills acquired by employees with the needs of the enterprise for quality assurance. The results of training are taken into account in the certification process.

The main reasons for the need for training and retraining of personnel directly at specialized enterprises of Russia are:

- competition, requiring a reduction in costs and more efficient use of labor resources;
- the emergence of new production processes;
- technological changes that require mastery of new knowledge and retraining of workers;

- lack of skilled labor at the national level;
- social responsibility of the enterprise for its employees, etc.

Thus, effective implementation of the quality management system requires the training of managers at different levels of the enterprise. Training should take place in the light of explaining the meaning of modern concepts of quality management, the need to ensure the effectiveness and flexibility of real quality management.

In addition, it is necessary to update the technical and technological support, which requires the following:

1. Finding the necessary funds for the purchase of equipment for testing materials and components – the task of each enterprise.
2. Implementation of electronic document management system.
3. Development and implementation of statistical methods of quality control.

3. CONCLUSION

As a result of the study, the following conclusions were made:

1. Russian industrial products lag far behind the western ones in terms of quality and manufacturability. This is due to the widespread obsolescence of fixed assets, inadequate staff qualification and inefficient management.
2. Improving the performance of domestic industrial production is impossible without an effective quality management system, in particular quality control functions.
3. The spectrum of existing methods and tools for quality control of products is quite wide and ranges from individual elements and technologies to the formation of a complex control system in the enterprise.
4. Improving the tools for quality control of industrial products at domestic enterprises should be focused on the application of new standards in the field of quality assurance, raising the level of skills of personnel and updating technical, technological and metrological support.

References

- Asyaeva, E.A., Chizhankova, I.V., Bondaletova, N.F., & Makushkin, S.A. (2016). Methods for assessing the credit risk of leasing assets. *International Journal of Economics and Financial Issues*, 6(1S), 96-100.
- Fedyukin, V. (2013). *Management of the Quality of Production Processes: a manual*. Moscow: KnoRus.
- Filippova, M.K., Mindlin, Y.B., Litvinenko, I.L., Kucherov, A.V., Shichiyakh, R.A., & Prokhorova, V.V. (2016). Rationale for the use of the cluster approach to the formation of localities in the regional economic system. *International Review of Management and Marketing*, 6(1), 20-26.
- Golovanova, N.B., Asyaeva, E.A., Gavrilenko, S.A., Temirkanova, A.V., & Sokolov, A.A. (2016). Funds management as relation system in business company for highly effective finance administration. *International Journal of Economics and Financial Issues*, 6(8Special Issue), 13-18.

- Gureva, M.A., Kirillov, A.V., Vinichenko, M.V., Melnichuk, A.V., & Melnychuk, Y.A. (2016). Management of innovations and innovative process: Concept, essence, classification and diffusion. *International Review of Management and Marketing*, 6(6), 147-153.
- Mechikova, M. (2011). *Structural-level Approach to the Development of the Institutional and Economic Mechanism of Industrial Policy* (Cand. Econ. Sciences).
- Mechikova, M. (2015). *Standardization, Metrology, Quality: Quality Management*. Taganrog: Stupin.
- Mechikova, M. & Novikov, N. (2015). Functional Role of Industrial Policy in the Strategy of Modernization of Russia's Productive Potential. *Bulletin of the Siberian Institute of Business and Information Technology*, 4(16), 58-63.
- Bashkov, A.A., & Silnov, D.S. (2015). Investigating the possibility of using piecewise constant functions in spectral analysis of signals. *International Journal of Applied Engineering Research*, 10(24), 44211-44213.
- Yakoreva, A., Biserova, V. & Demidova, N. (2007). *Metrology, Standardization and Certification*. Moscow: Eksmo.