Methodology for assessing and improving the competitiveness of enterprises in the real sector of the economy

Elena Pesotskaya[1], *Almaz* Khakimov [1,] and *Irina* Alpackaya[2,*]

[1]Sankt-Petersburg State Economic University, 21, Sadovaya street, St. Petersburg, 191023, Russia
[2]Moscow State University of Civil Engineering, 26, Yaroslavskoye shosse, Moscow, 129337, Russia

Abstract. High rates of the development of market relations and international integration processes imply an increase in the level of competition in leading sectors of the economy, which include energy, construction, industry enterprises and others. The purpose of this paper is to develop a universal methodology for assessing and improving the competitiveness of enterprises in the real sector of the economy. The paper analyzes the structure of cost for quality of products, examines the life cycle of the object in order to determine the approaches to the development and implementation of quality management systems. Using various methods of research, recommendations on the formation and implementation of quality management systems in enterprises of the real sector of the economy were developed in order to increase their competitiveness.

1 Introduction

Competition of producers of goods and services for markets in order to obtain high financial results is the basis of market relations in any sector of the economy. Despite the fact that general approaches to the understanding of competition and competitiveness are applicable to any industry, the features of enterprises in the real sector that influence the formation of a competitive environment were identified in the course of this study. These include: the regional nature of competition, weakening as a result of integration, including international, and the prevalence of price competition in the industry.

Competitiveness of an enterprise and competitiveness of a service (product) are different concepts. Competitiveness of a service is its property to be in the market along with similar services present there [1]. This property reflects the compliance of the service with technical parameters (consumer properties), regulatory (compliance with existing standards and norms) and economic parameters (price and cost of operation). Competitiveness of an enterprise is the ability to produce goods and services that are more attractive to the clientele than the goods and services offered by a competitor by their cost and combination of other characteristics (quality, etc.). Comparison of the concepts shows that two companies that offer services that are equally competitive in these indicators may

* Corresponding author: alpackaya-irina@mail.ru

differ in their level of competitiveness [2]. To ensure its competitiveness, the company strives to outpace competitors in such parameters as the service production technology, practical skills and qualifications of personnel, the level of strategic and current planning, the range of provided services, management control, quality of management systems, etc.

2 Materials and Methods

Factors affecting the level of competitiveness of any enterprise can be divided into two groups: external factors reflecting the working conditions of the enterprise, which are expressed in the ratio of supply and demand for its services, market models, taxation system, state support of the industry, etc., and factors depending on the work of the enterprise and describing the effectiveness and quality of its work [3].

In the category of "efficiency", the essence of economic development is accumulated: the progress of productive forces, the growth of production and services, the reduction of cost of their production, the organization and management of these processes. Therefore, efficiency can be considered as one of the most synthetic economic categories. In this study, a socio-economic approach was chosen, which determines the efficiency of production as the ratio between the sum of produced use values and the sum of all the labor used for this (live and materialized). Theoretically, the validity of this approach is indisputable, but there is practically no indicator for the quantitative measurement of different use values, and, ultimately, this definition of production efficiency is reduced to the ratio of result to cost or resources [4].

The presence of quality management system at the enterprise is the second major factor of competitiveness. Quality is inextricably linked with its economy. With a low quality, additional expenses of all resources for the correction of defects made in the project arise inevitably [5]. The structure of the cost for quality is presented in Table 1.

Table 1. The structure of the cost for product quality.

Costs			
for compliance		**for non-compliance**	
1. For preventive measures	2. For assessment	3. For internal defects (losses)	4. For external defects (losses)
1.1. Preventive actions: quality management; process management; quality assurance of supply; quality system audit, quality improvement program; training of quality issues	2.1. Inspection and testing (detection of defects after manufacture)	3.1. Alterations and repairs	4.1. Alterations and repairs
1.2. Corrective actions (preventing the recurrence of identified defects)	2.2. Process control (detection of defects in production)	3.2. Re-check and testing	4.2. Re-check and testing
1.3. Metrological provision of production	2.3. Audit (input control)	3.3. Analysis of losses	4.4. Analysis of losses
1.4. Quality system audit		3.4. Concessions (approval of materials that do not meet the requirements)	4.5. Warranty policy
1.5. Introduction of new equipment and technology			4.6. Legal disputes

The organization of a quality management system contributes to reducing the overall cost for quality and, moreover, changing their structure - the proportion of preventive costs increases, while all others decrease. High quality of products reduces production and operating costs, increases the competitiveness of products and enterprises - project participants, more fully meets the needs of the market, consumer value of the product, and creates the image of companies. In recent years, quality has become a determining factor in competition [6]. The important point is that the applied tools for quality control of products have a relatively small effect if they are not supported by the policy and style of the company. It should be noted that in modern conditions, the quality management system must comply with international standards.

3 Results

To develop recommendations on the formation and implementation of quality management systems at energy enterprises in order to increase their competitiveness, let's consider the results of the object life cycle study using the example of building energy facilities (heat networks):

1. Stage of marketing research. The customer determines the idea of the project and its purpose by means of marketing research with the involvement of experts.

2. Organization of competitive bidding and evaluation of bids:

During the life cycle of heat networks, there can be at least two such stages: a tender for design and tenders for contract construction and other works.

3. When developing a project, the main indicators of quality and cost are taken into account with the features of its construction and operation. The main document containing the requirements for the quality of the project is an accurately formulated "Technical task" for the development of the project with an indication of the beginning, end, category, intermediate points, and all necessary input data, competent calculation of all elements of the future heat network, taking into account the terrain, road and climatic zone district, properly compiled estimates.

4. At the construction stage, project indicators are implemented. Maintaining project cost and quality indicators significantly depends on the quality of the process.

5. When the construction is completed, first the working and then the official state commission that accepts the object for final operation is convened for the acceptance of the object into operation.

Thus, the cost of contract work for the construction of heat networks as a price factor of competition is formed at the design stage of construction objects, manifests itself at the bidding stage, is fixed at the contract conclusion stage, and is maintained at the construction stage [7].

The quality level is established at the pre-design stage in the development of regulatory documentation, maintained during design, ensured in the manufacture of materials, structures, parts, and products, construction and installation works, and maintained during operation. Obviously, to achieve the required level of quality of the final construction products, an appropriate level of quality of products, works, and services must be ensured by all project participants at all stages of the creation of the final product. This predetermines the need for an integrated approach to the management of production and economic processes based on a system of total quality management, which does not exclude, but confirms the need to create quality systems at each enterprise. The study of the process of formation of the quality level throughout the entire life cycle of an object from marketing research to operation revealed the construction stage as determining in this process at present, and also identified the problems of quality assurance at this stage [8].

Orientation to international standards and requirements determined the use of the recommendations of the ISO standard in the development of a life cycle diagram (Fig. 1)

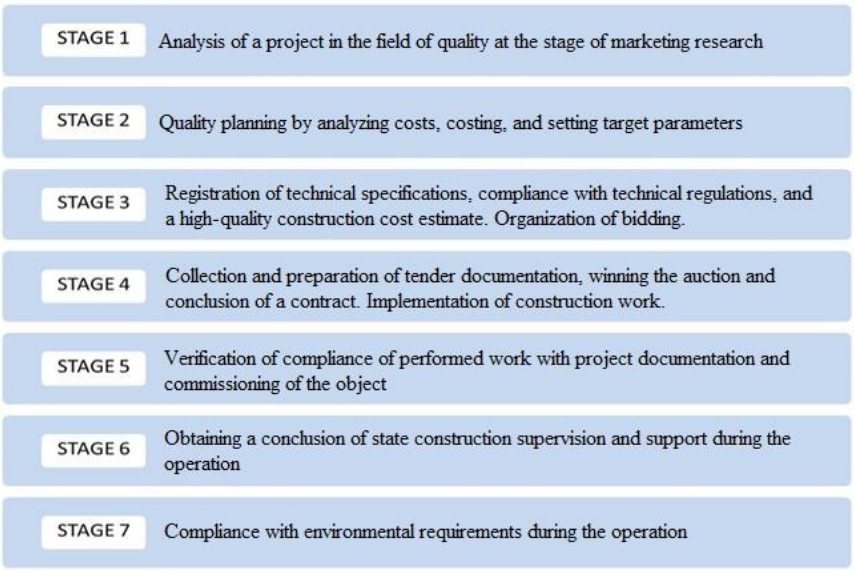

Fig. 1. Life cycle of heat networks.

Construction quality management refers to the development and implementation of a set of technical, economic, and organizational measures at all stages of the creation and operation of final construction products and management levels aimed at establishing, ensuring and maintaining the required level of quality, carried out through systematic control, strict implementation of other management functions, and targeted impact on the conditions and factors affecting the quality of these products. Many principles of the concept of administrative management continue to be fundamental factors, but they are enriched with economic content [9]. The work on quality traditionally started at the final stages of the technological process in the form of control operations is now performed at each technological stage, being an integral part of the production process and represents, above all, the work on improving quality products and reducing its cost.

In general, the cost of providing the required level of quality of heat networks can be defined as the sum of the costs at the design (project), building, and operation (exploitation) stages:

$$C = C_{pr} + C_{bd} + C_{exp} \quad (1)$$

The cost of the project depends on its complexity, level of quality, design time, which can be represented as:

$$C_{pr} = f_1[K(t), t_p] \quad (2)$$

where K—complex quality factor of the designed object;

t_p — project design time;

t— period under consideration.

At the construction (building) stage, the cost of quality depends on the constructive and technological complexity of the work, the economic, technical and organizational level of production, the volume of construction and installation works, the level of product quality

management, and other factors. The cost of building a unit of production can be expressed as

$$C_{bd} = f_2[K(t), Y_{pr}; X_{pr}; Y_{y;} t] \quad (3)$$

where Y_{pr} - economic, technical and organizational level of production;
X_{pr} - volume of production;
Y_y - level of product quality management;
t - construction period of the object.

The costs at the exploitation stage mainly depend on the complexity, maintainability of the heat networks, its wear and tear, etc.

One of the ways to improve the quality of construction of energy facilities is to improve the existing quality system of engineering companies by creating a quality management system in accordance with ISO 9000.

According to the results of the analysis of domestic and foreign theoretical and practical experience in the field of quality management, the main trend is the transition from the concept of optimal quality to the concept of a quality management system based on International Standards on Quality Control (ISQC). ISQC establish requirements for a quality management system aimed at satisfying a consumer by preventing product non-compliance with regulatory requirements at all stages from design to operation. In the world practice, construction industry enterprises have long ago switched to relationships with their suppliers and customers based on quality systems. Participation in any competitive bidding is impossible without a proper certificate. This refers to the building up the work of the entire enterprise on the quality management system (QMS) in accordance with the requirements of ISO 9001, which establishes a process approach to quality management issues in order to improve the process from the purchase of raw materials to production. It should be noted that the standards do not depend on a particular industry, do not require the creation of an absolutely new QMS instead of the one at the enterprise, but only offers to modify it [10].

The quality management systems of all developed countries are similar in nature. The mechanism of implementation and development of these systems is also universal in its essence [11]. Table 2 summarizes the results of the analysis of international experience in quality management.

Table 2. Comparison of approaches to quality.

US and European approach	Japan's approach
Quality is based on low prices	Quality is based on a low level of defects
The first goal is profit, quality is the random category	The first goal is quality, profits will not be slow to follow
For quality issues, buyers must request supplier consent	Accepting customer requirements for quality issues
General ideas about quality	Strict quality policy for each item

The whole variety of approaches to quality management can be divided into two main areas:

1. Administrative approach
- improving the quality of products up to 100%
- achieving the required quality of products is divided into stages of the product life cycle
- occurrence of defects is considered as an emergency that needs to be fixed at any cost

2. Economic approach
- the calculated level of product quality is made dependent on the economically expedient value of costs to achieve it

- with the further increase in the cost of quality assurance, there is a decrease in the corresponding return on the invested monetary unit

In the course of the study, factors that influenced the development and implementation of a quality management system were identified: the specific needs of the organization, its specific objectives, the supplied products and services, as well as the applied production processes and practical experience. Based on the results of the study, methodological recommendations on the formation of a quality management system (QMS) of engineering companies have been developed in accordance with the requirements of the international standards of the ISO 9001:2000 series and documents of major customers and supervisory organizations [12].

It is recommended to carry out the formation and implementation of the QMS by the following method (Table 3)

Table 3. Methodology for the formation and implementation of QMS.

Stage	Name	Content	Term
1	Statement of intent	The top management of the enterprise will resolutely follow the strategy of "Enterprise management through quality management"	1-3 months
2	Preparation for the introduction	Personnel training for new methods Planning the development of documentation for quality management in the central office and in departments, divisions, and workshops Development of documents describing the quality system Identification and description of key processes First expert assessments and self-assessments of the quality level of an enterprise using express-methods based on the TQM (Total Quality Management) quality management model	3-4 months
3	Introduction	Active development of quality management documentation in the central office and preparation for the description of processes in departments and workshops	About a year
4	Promotion	Finishing the development of quality guidelines and basic procedures. Internal quality audits Audits by customers and consumers Supplier audits The system is ready for certification – certification	One year and more
5	Development	Optimization of key processes. Improving the quality system of documentation based on the gained experience Self-assessment — monitoring, identifying trends — highlighting areas for improvement	One year and more
6	Successes and progress	Development and implementation of methods for the economic efficiency of quality management Organization of the exchange of business information from top to bottom, from bottom to top, and horizontally Exchange of experience between departments, workshops, as well as allied and related enterprises (benchmarking) Creation of own quality management sphere, which includes regular and prospective customers, consumers, and suppliers Development of goals, objectives and action program for the next round of a large Deming cycle	About a year

4 Discussions

Creating a QMS complying with international standards will not only increase the efficiency and competitiveness of individual enterprises of the construction complex, but

also the main economic effect will manifest itself at the level of the national economy by improving the quality of heat networks and the state of energy facilities in general

5 Conclusion

As a result of analysis of domestic and foreign experience in quality management, it was found out that one of the ways to improve the quality of power engineering construction is to improve the existing quality system of engineering companies taking into account the requirements of ISO 9000 international standards. A methodology has been developed for the formation of an integrated quality control system for the construction of energy facilities based on the use of new approaches to quality assurance, the use of more durable materials, the most efficient technologies to ensure quality control, as well as modern machinery and equipment, ensuring longer operation of energy facilities in various climatic conditions.

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