Nomenclature of Works and Costs for Ensuring the Quality of Construction Products. Identification Methods.

Pavel Zhuravlev¹, Evgeniy Bachus¹, Irina Markova ¹*

¹ Moscow State university of civil engineering (National research university) (NRU MGSU) 129337, 26, Yaroslavskoye Shosse, Moscow, Russia

markova@mgsu.ru

Abstract. The issue of quality control of construction products requires close attention in the paradigm of modern management, focusing on this aspect of it — the costs of investment and construction activities and their impact on the performance of the corporate level, identifying those groups of costs for ensuring the quality of construction products that can be foreseen and excluded. Within the framework of modern economic concepts, it is very difficult to verify the concept of costs of ensuring product quality (including construction), because in one way or another all activities related to the production of products are related to its quality. This fact makes it difficult to accurately define the concept of the cost of ensuring product quality, since there is no difference between the costs of ensuring product quality and the costs of other activities. The article addresses the need to form a common system of methods, criteria, indicators for assessing the cost of quality assurance, as well as organizational structures for making organizational and technological decisions to ensure the quality of construction and regulatory and analytical support for this kind of activity at the corporate level.

1. Introduction
Identification of the cost of ensuring the quality of construction products allows for a comparative analysis of the costs of preventing defects, assessing product quality and costs due to the correction of internal and external defective products. As a result of this procedure, this is the establishment of competitiveness and sustainability of the product quality management subsystem within the overall management system of the investment and construction activities of the corporate level.

In this regard, the main objectives of the analysis of the cost of ensuring the quality of construction products are:
- determining the amount of costs to maintain a certain level of quality of construction products;
- establishing the possibility of reducing the cost of ensuring the quality of construction products by determining the costs in respect of internal and external defective products, which can be avoided;
- determining the costs of measures to prevent defect and to assess the quality of construction products.

2. Methods
The experience of domestic and foreign firms shows that the increase in costs for the prevention of defect increases the possibility of a significant reduction in costs due to the presence of internal and
external defective products, and, consequently, a reduction in the cost of ensuring the quality of construction products.

In the same context, we note that the practice of managing the quality of products of leading foreign companies indicates that the additional expenditure of one monetary unit in the area of marriage prevention has the multiplicative effect of reducing costs to correct defective products in the amount of 5 ... 15 units [1-3].

In this regard, it seems appropriate at the corporate level to pay special attention to the cost of preventing defect, although an increase in such costs will not immediately give positive results due to the presence of some time lag between cause and effect (result). Also, attention to the cost of preventing defect is levelled due to the pursuit of economic entities for greater profits and the difficulty of determining the amount of profit from invested funds in the damping of defect [4-6]. Abroad it is customary to single out the following relative cost structure for ensuring product quality (Table 1).

**Table 1.** Cost structure for ensuring the quality of products of some foreign companies in the field of engineering

| The name of the cost of product quality | Share in total % |
|---------------------------------------|-----------------|
| Costs due to the presence of internal defective products | 25…40 |
| Costs due to the presence of external defective products | 20…40 |
| The cost of assessing the quality of construction products | 10…50 |
| Defect prevention costs | 0,5…5 |

This table shows that the cost of defect prevention is the smallest part of the cost of ensuring product quality. It should be noted that in foreign companies there are certain limiting proportions, for example, the cost of preventing defect should be at least 10% of the cost of ensuring product quality, in the case where the costs due to the presence of internal and external defective products are 50%.

Despite the fact that these proportions are approximate, they can be used as a guide when making decisions in the analysis of the costs of ensuring the quality of construction products.

Such an analysis assumes the establishment of certain trends at the level of an economic entity to ensure the quality of construction products, which implies a comparison of the level of costs to ensure the quality of construction products for different periods of time and extrapolation of their development to the perspective given by the research horizon.

The presence of periods in which the cost of ensuring the quality of construction products increases dramatically, identifying the reasons for this leap and further measures to control the quality of construction products indicate the need for developing quality assurance programs for building corporate level as one of the most important elements of quality management [7; 8].

3. Results and discussion
In foreign practice in the complex of these measures, the most common and effective method for analysing the costs of ensuring product quality is the Pareto chart, which establishes the necessary indicators to identify the main weaknesses at the level of an economic entity, as well as the most important factors and areas that need to be influenced to achieve the goals organizations both operational and strategic, related to product quality, for example, to improve it, reduce labour intensity, materially own production, increase productivity.

In this context, it seems appropriate to the use of the above method is the first step in a complex of measures of corporate-level cost analysis to ensure the construction quality of products, reducing the share of its defect, the possibility of recycling and re-use of resources used for the creation of low-quality product, and damping factors negatively affecting the quality of construction products.
In the future, to form an idea of the level of costs (low or high) for ensuring the quality of construction products, the values that characterize them should be compared with other values of parameters of the same character within the framework of the system of indicators for estimating the costs of ensuring product quality, taking into account the specific conditions of each business entity, and general provisions that characterize:
1. differences in the degree of complexity and uniqueness of the construction products of each enterprise, methods and volumes of its production, market features;
2. the disagreements of contracting organizations in determining the principles for assessing the cost of ensuring the quality of their common construction products;
3. differences in organizations in the degree of attention paid to activities and, accordingly, the use of indicators of the cost of ensuring the quality of construction products.

In this regard, to assess the cost of ensuring the quality of construction products, you can use the following indicators:
1. Cost and wages. It covers all types of direct costs, overhead costs, including payments to employees engaged in construction industry;
2. The volume of building and construction works. He directly links the costs of ensuring the quality of construction products with the actual work performed for a certain period by assigning the costs of ensuring the quality of construction products to the indicator of the cost of construction The volume of building and construction works;
3. Construction products transferred to the customer. This indicator determines the impact of costs on ensuring the quality of construction products on the amount of profit of an economic entity.

It should be noted that the joint use of several indicators for assessing the cost of ensuring the quality of construction products makes it possible to avoid the shortcomings of individual indicators [9–12]. For example, the indicator “volume of building and construction works”, although it is considered the most suitable for evaluation, has next drawbacks:
1. the cost of ensuring product quality does not coincide in time with the sale of construction products;
2. fluctuations in the market for contractual services, significantly affecting the volume of building and construction work. Therefore, it is usually supplemented in the analysis with an indicator of cost.

In the light of the current state of affairs in construction companies, the assessment of the effectiveness of quality control of their products should take into account that this control is a subsystem that is an integral part of the investment management system at the corporate level. The main components of this subsystem are the incoming and outgoing elements (results), their changes at the cost of ensuring product quality. Incoming items represent the cost of preventing marriage, assessing product quality, and leaving items are the costs due to the presence of internal and external defective products (Figure 1).

Since the basis for evaluating the effectiveness of this system is the control of incoming and outgoing elements, it is necessary to focus on this genesis in assessing the effectiveness of product quality control in an enterprise.

4. Conclusions
Based on the above, we can state that there is a need to form a common system of methods, criteria, indicators for assessing the costs of quality assurance, as well as organizational structures for making organizational and technological decisions to ensure the quality of construction and regulatory and analytical support for this kind of activity at the corporate level.
At the present stage, an important condition for the formation of the above systems is the identification of the range of costs for ensuring the quality of construction products, which allows the construction company to continue the strategic line in its sustainable and progressive development and more efficiently use its limited resources.

Classification of the cost of ensuring product quality makes it possible to compare the costs of preventing defects on the costs of assessing product quality as inputs to the quality management system, with costs due to the presence of internal and external defective products, and exit from this system.

The nomenclature of costs for ensuring the quality of construction products must meet the needs of each individual economic entity due to the presence of its own internal and external conditions, so each of them must have its own composition of such costs, reflecting the nature of its activities and meeting the goals and capabilities of the construction organization.

References
[1] S.B. Sborshikov, Logistics of regulatory impacts in the investment and construction sector (theory, methodology, practice), dissertation for the degree of Doctor of Economics, Russian Economic Academy. G.V. Plekhanov, Moscow, 2012.
[2] P. A. Zhuravlev, On the use of resource-technological modelling in the form of investment programs, Bulletin of the Irkutsk State Technical University, No. 7, pp. 198-201, 2017.
[3] P. A. Zhuravlev, The price of construction and the stages of its formation, Bulletin of the Irkutsk State Technical University, No. 9 (104). pp. 174-178, 2015.
[4] E.E. Ermolaev, Features of determining the fixed cost of construction in the framework of state programs, Vestnik Universiteta, GUU, No. 11, pp. 45-49, 2013.
[5] E.E. Ermolaev, Management of the use value of construction sites, Humanities and social sciences (electronic journal), No. 3, pp. 18-23., 2013.
[6] A.V. Alexanin, Evaluation of the economic efficiency of the use of new technologies, materials and solutions in energy saving projects, Vestnik MGSU, № 1, pp.125 - 129, 2009.
[7] Ya.V. Zharov, Accounting for organizational aspects in the planning of construction in the energy sector, Journal of Civil Service, № 5, pp. 69-71, 2013.
[8] E.E. Bakhus, To the question of improving the organizational and technological solutions to ensure the quality of construction of nuclear power facilities, Scientific review, № 14. pp. 20-23, 2016.
[9] N.M. Shumeyko, Substantiation of the unified form of local estimate for design work, Herald of civil engineers, № 6 (53), pp. 300-305, 2015.
[10] N.M Shumeyko, Development of methodological recommendations for the application of a new template LS-P (SH) for determining the cost of design works, Estimated-contractual work in construction, No. 1, pp. 19-20, 2016.

[11] N. V. Lazareva, Value engineering as the basis for the integration of planning, financing and pricing processes in investment and construction activities, Vestnik MGSU, № 11, pp.178 - 185, 2015.

[12] Lyapin AV, Lyapin V.Yu. Modern Approach to the Organization of Estimated Activity in Construction, Scientific review, No. 8, pp. 251-255, 2016.