Application of an Effective Quality Management System at the Enterprises for the Production of Reinforced Concrete Products and Structures of the Penza Region

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Abstract. In this article the quality management system at the enterprises on production of reinforced concrete products and designs of the Penza region is considered. The main characteristics of enterprises in this industry, which speak of the need to improve the competitiveness of enterprises of building materials for a stable position in the market. The main factor in the competitiveness of enterprises can be indicators of product quality. The analysis of the quality management system at these enterprises. All types of quality control are considered in detail. The procedures taking place at each stage of quality management at the enterprises for the production of concrete products and structures of the region are described. The General provisions on quality management which are available on them are revealed. Shortcomings of the existing system are specified, proceeding from it recommendations on effective quality management at the enterprises of the region are offered. These recommendations will bring enterprises to a new level of production and ensure the quality and competitiveness of enterprises. The application of the new quality management system is considered on the example of the company LLC “Building materials”, one of the main market participants in the production of concrete products and structures of the Penza region. The calculation of the efficiency of the new quality management system is given.

1. Introduction
The construction market including the industry of construction materials plays a significant role in the economy of the city, region, country. His condition is one of the indicators of the level of economic and social development [1].

Housing construction largely depends on the state of production of building materials, products and structures, since the share of construction materials in the structure of the cost of construction and installation works is on average more than 60%. This indicates that the cost of housing depends largely on the price of building materials.

2. Materials and research methods
As for the market of building materials of the Penza region and the city of Penza, the materials that meet European standards are not enough. The existing capacity of the existing enterprises of the construction industry is much inferior to foreign analogues, require large expenditures of labor, materials, energy, insufficiently automated and mechanized, which makes them low-profit. In this regard, signif-
significant investments are required for the modernization of production, the introduction of new technologies and equipment [2].

The market of production of reinforced concrete designs and products is an integral part of the market of construction materials of the Penza region. This market is represented by five main participants (plant ZHBK-1, LLC "Building materials", LLC "Pus", LLC "Concrete").

After analyzing the market of concrete products in the Penza region, we can draw a number of conclusions:

1) the industry shows a decline in concrete products (-5.7% compared to 2016.);
2) the market of concrete products has only local character, the production having a sales market in the whole country is simply not, it is easier to import raw materials for concrete products to the region than the concrete products to other regions.
3) capacity utilization of enterprises of the industry for the last 3 years, on average, about 60%, which reflects the dynamics of the closure of about 5-7% of enterprises per year.

All these data suggest about the necessity of improving the competitiveness of the enterprises of building materials for sustainable market position.

The main factor of competitiveness of the enterprise is the quality indicator reflecting image of the company and directly influencing its profit [3]. The customer of the enterprise, and especially in such an industry as construction is not important product price, quality comes to the fore. Enterprises with high quality products have the least number of complaints, which indicates lower costs and higher profits.

Consider the quality management system at the enterprises for the production of concrete products in the Penza region.

The quality management system at the specified enterprises of the region consists of interrelation of all structures and divisions of the enterprises responsible for timely production of goods, its appropriate quality and timeliness of delivery with the least expenses.

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Today at the enterprises four types of quality control of products are carried out it is entrance, operational, acceptance and periodic.

Input control is subject to all without exception, production materials used in the manufacture of concrete products, with full compliance with regulations (GOST, TC). The main task of the input control is the screening of goods of inadequate quality. Each material used in the production must be accompanied by a certificate or quality certificate. Their accounting is conducted in Excel tables, all input materials are recorded. Materials that do not have a certificate or quality certificate, as well as further detection of non-compliance with the standard of quality, are not allowed in production. The complaint (marriage) is served in accordance with the "Instruction on the procedure for acceptance of products for industrial purposes and consumer goods by quality". Input quality control of products is regulated by GOST 24297-87 "Input quality control. Fundamentals.»

Operational quality control is carried out continuously and takes the entire process of production of concrete products from the beginning of production to the moment of loading to the customer. All processes are performed on special equipment or by means of small mechanization. This reduces the percentage of possible marriage issue to a minimum. In the course of operational control at the enterprises, check concrete products the manufacture, laying and compaction of concrete mix, size and build quality steel shapes, placement of rods and fixings, as well as established modes of thermal processing of concrete. In the final stage of manufacturing masters check the quality of molded products.

The application of operational monitoring enables the identification of the causes of spoilage. Operational control involves the use of techniques related to the manufacture of a particular type of product, however, adjusted to the internal characteristics of the enterprise, based on General principles.
Acceptance quality control is the closing link of production of concrete products. It is a complete check on the compliance of the finished product, the requirements of GOST or TC. Here check property of a finished product, estimate its appearance and geometrical parameters of concrete goods. In necessary cases, the finished products are tested for strength, stiffness and crack resistance.

The results of all types of control (input, operational and acceptance) are recorded in Excel tables, the results of samples in the factory laboratory are also fixed.

Acceptance of designs is carried out in batches. The structure of the party includes the designs of one type consistently made by the enterprise on one technology within one day from materials of one type.

At production of designs irregularly or in small quantity, at ensuring uniformity of quality of production, it is allowed to include the designs made within several days, but no more than one week in structure of party.

Periodic quality control is that most of the parameters of the products are subjected to control and testing once a year.

Sample control is prescribed with full production stability, when the statistical uniformity of the production process is guaranteed.

In the sampling method, control on an alternative basis should be used primarily.

However, the methods and means of control at the enterprises leave much to be desired, since the enterprise does not provide control cards, there is no single database of document flow, not at all stages there are production standards, the whole system is not uniform. Basically, a large sample is subject to visual inspection only, 2-3 units of products are checked for quality in the laboratory.

A common disadvantage of the existing quality management system is that it is outdated, it covers only one division of the enterprise – “production”, and extends to one stage of the project – "production". The modern quality management system according to ISO 9000: 2015 standards of production shall extend to all stages of its production and cover all divisions.

Thus, recommendations on quality management and competitiveness for enterprises of the Penza region are proposed to conduct a number of activities. Namely, the introduction instead of the existing system, GOST ISO 9001:2015, which will bring the company to a new level of production and quality assurance and competitiveness of the enterprises.

The new quality management system should cover all business units.

3. Research result

Consider the use of a new quality management system on the example of the company "Building materials", where there is only production control.

It is expected the introduction of the control of all departments according to ISO 9000:2015. In the marketing Department, input control should be subject to all incoming information for errors, inaccuracies, omissions. In most cases, if the information received from the contractor does not raise questions, it includes it in the work, and if the information is incorrect, corrections are received already when resources are spent on its processing. In this case, the cost of resources for primary control will be significantly less than the possible cost of corrections.

Operational control in the marketing Department should be carried out in the process, the person responsible for maintaining the level of quality of the work performed. For the organization of operational control it is necessary to enter into duties of the head of Department or his Deputy to carry out this type of control.

Acceptance control here refers to the verification of the final results of the marketing Department, in particular: business proposals, reports, analyses and forecasts. Acceptance control should be carried out by the same employee, whose duties are operational control. To prevent possible errors and inaccuracies, as well as for the analysis of already accomplished, a form Of "accounting for errors" is introduced, in which they are recorded.
The Finance Department should subject all incoming documentation to incoming control. Special control should be subject to documentation and information that falls directly into these departments, bypassing the marketing Department.

Operational control should be carried out by the heads of these units or their deputies authorized to do so. Acceptance control in these departments should be carried out very carefully, as the result of the work of these departments are legal and financial documents.

A special place in the system of integrated product quality management is the stage of development of internal documentation. This stage has the longest length and therefore the "price of error" here is the maximum. Incoming control at this stage should be subject to all documentation coming from all parts of the enterprise.

The main stages of document management in the enterprise according to ISO should be as follows:
- implementation of planning and development of documents;
- coordination and approval of documents;
- ensuring the adequacy of documents;
- approval of documents confirming the adequacy before their release;
- updating, identification of changes and re-approval;
- ensuring the availability of valid versions of documents in the field of their application;
- clarity of documentation, ease of identification;
- ensuring identification of documents of external origin and management of their distribution;
- prevention of unintentional use of outdated documents, and the use of appropriate identification, if necessary, their storage.

The document flow of the quality management system should include all types of documents regulating the parameters of product quality, creation processes. Figure 1 shows a new possible workflow of LLC "Building materials".

Thanks to the new document management quality will make all parts of a single system capable of, if necessary, to view common standards, methodological instructions and other documents regulating the activities of the enterprise.

Operational control, in turn, should be carried out in the course of work directly by the head of the Department. Acceptance control is also carried out by the head in accordance with the rules of acceptance.
Figure 1. Structure of document flow of quality management system of LLC "Construction materials".

Periodic quality control should also be carried out in the above-mentioned departments. To do this, it is proposed to introduce the so-called "quality days", held at regular intervals in each unit.

Innovation will not only produce high-quality products, but will make its production more economical.

As an indicator of the effectiveness of the new quality system, the coefficient of labor efficiency is proposed, expressing the ratio of the useful result to the cost of obtaining this result. The increment of this coefficient, due to the influence of the created quality system, is characterized by the effectiveness of this system.

The value of this indicator is defined as the ratio of:

\[ K = \frac{\text{incremental savings or redundant labor in consumption of a unit of production after the introduction of a quality system}}{\text{the value of the increment of living labor costs due to the development and implementation of the quality system}} \]

Calculation of these values for LLC "Building materials" showed that

the incremental savings or redundant labor in consumption of a unit of production after the introduction of a quality system = 34215 thousand rubles., the value of the increment of living labor costs due to the development and implementation of the quality system = 14778 thousand rubles, respectively:

\[ K = \frac{34215}{14778} = 2.3 \]

The condition of economic efficiency of a rationally functioning quality system is \( K > 1 \)

This inequality is as follows \( 2.3 > 1 \)

As we see the condition is fulfilled, therefore, according to the indicators of labor efficiency, we can judge the effectiveness of the implemented quality system. A positive aspect of this approach is that when calculating the indicator, the assessment is made by the ratio of the result obtained from the implementation of the quality system to the labor costs for the development and implementation of this system.

4. Conclusion
Calculation of this coefficient for LLC "Building materials" before and after the proposed activities, shows that it increases by 2.3 times, which indicates the effectiveness of the proposed system, which means the quality of products is improved, the competitiveness of the enterprise increases, which will contribute to a greater volume of orders and profit growth [4].

5. References
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