

## Assessment of Competitiveness of Construction Production

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### Abstract

The technique of assessing the competitiveness of construction products, taking into account the level of product quality, reproducible manufacturing process, as well as its cost. In the process of estimating the quality of the products it is advisable to use either the most significant indicators of the quality of products or generalized indicator of quality, taking into account the totality of the properties of the products in question. The evaluation procedure of the generalized indicator of quality products includes a selection of the most important indicators of the quality of the finished product and the assessment of weighting coefficients of each of the properties under consideration using expert method. Normalized the evaluation of the quality indicators can be obtained using the desirability function Harrington. In assessing the competitiveness of construction products are encouraged to consider the reproducibility of the process in terms of reproducibility index  $C_p$  or  $C_{pk}$ . Found that these criteria are continuously improving enhances customer satisfaction, which in turn leads to an increase in profit.

**Keywords:** competitiveness, generalized criterion of quality, price level, the reproducibility of the process

## 1 Introduction

Improving the competitiveness of construction products - one of the most pressing issues, as the main factor characterizing the competitiveness of products is its quality, and the quality of construction products - is not only the needs of consumers, but also their safety. The development of fair competition construction products promotes innovation, improve product quality, reduce technical barriers to trade, increase the level of safety of life and health, environment and saving all kinds of resources. Furthermore, the quality of construction products - the main factor affecting the efficiency and profitability of the completed building project, providing reliability and durability. To continually improve performance of construction industry must improve the processes by improving their performance and improve the quality of products.

## 2 Experimental study

At the same time the competitiveness of products determined by a combination of quality and value of products features that contribute to meeting the needs of the consumer. Continuous improvement of the quality of products provides greater customer satisfaction and allows to increase the price. Therefore, improving product quality improves profits. Product quality can be estimated using the generalized indicator of quality is either the most significant indicator of the quality of the product or set of properties of the products in question [1, 2]. Normed assessment of quality indicators can be retrieved using the desirability of Harrington. It should be noted that in most cases the company carries out random checks, which, for all its efficiency makes it impossible to get enough objective information about the quality of the party as a whole, which in today's competition between producers can lead to the production of defective products. Using the same continuous control is not always possible, either because of features of the production cycle, either because of the high costs of the organization of the controls. Therefore, for the control of production processes is necessary to use statistical methods to obtain timely information about the quality of processes and allows you to quickly respond to possible failures. Under these conditions, special attention should be paid to the stability and reproducibility of the process. The stability of the process is usually estimated by Shewhart control charts and process capability - in terms of reproducibility index  $C_p$  и  $C_{pk}$  [3].

$$C_p = \frac{Z_b - Z_n}{6\sigma}; \quad C_{pk} = \frac{|\bar{X} - Z_{np}|}{3\sigma},$$

где  $Z_b$  – the upper limit of the tolerance

$Z_n$  – the lower limit of the tolerance

$Z_{np}$  – one of the limits of tolerance

$C_p$  – process capability index, appreciate the opportunity to meet the technical approval without regard to the average value

$C_{pk}$  – index of process capability based on the actual situation of the average value.

Another very important indicator of the competitiveness of products is its cost, which ultimately affects the consumer demand.

Thus, the competitiveness of construction products is determined by the level of its quality, stability and reproducibility of the process of production, guarantees a stable product quality and its value [1 ... 4]. Continuous improvement of these criteria help to improve customer satisfaction, which in turn leads to increased profits.

Dedicated criteria (properties) can be grouped into the following quality criteria for generalized form:

$$\Phi_n = \alpha_1 K_{C_p} + \alpha_2 K_Q + \alpha_3 K_p,$$

где  $K_{C_p}$  – coefficient characterizing the criterion index reproducibility of the process;  $K_Q$  – coefficient characterizing the criterion of the generalized level of product quality;  $K_p$  – coefficient characterizing the criterion level of prices of products on the market.

Competitiveness indicators and formulas for calculating them are presented in table 1.

**Table 1: Competitiveness indicators and formulas to calculate them**

Indicator	The formula for calculating	Note
Criterion index reproducibility of the process	$k_{C_p} = \frac{C_p}{C_{p,\max}}$	<p><math>C_p</math> – index of reproducibility of the process;</p> <p><math>C_{p,\max}</math> – the best value of the index of reproducibility of the process of competitor.</p> <p>The index of the reproducibility of the process was evaluated based on the following criteria:</p> <p><math>C_p &gt; 1,33</math> nice one;</p> <p><math>C_p = 1,33-1,00</math> requires careful observation;</p> <p><math>C_p &lt; 1,00</math> unsatisfactory.</p>

**Table 1: (Continued): Competitiveness indicators and formulas to calculate them**

Criterion level of product quality	$k_{Qn} = \frac{Q}{Q_{\max}}$	<p><math>Q</math> – generalized indicator of product quality;</p> <p><math>Q_{\max}</math> – the maximum value of the generalized indicator of product quality competitor;</p> <p>At the same qualitative scale as the desirability for the desired properties, and for generalized index as the next:</p> <p>от 0,90 до 1,0 - very well;</p> <p>от 0,8 до 0,90 - very good;</p> <p>от 0,63 до 0,8 - good;</p> <p>от 0,37 до 0,63 - satisfactorily;</p> <p>от 0,2 до 0,37 - poorly;</p> <p>от 0,0 до 0,2 - very bad.</p>
Criterion price level	$k_p = \frac{P_{\min}}{P}$	<p><math>P</math> – the price of products on the market;</p> <p><math>P_{\min}</math> – minimum value prices product quality competitor in the market</p>

The practical value of this approach is illustrated by an example of products from different manufacturers. Input data for these calculations are presented in table 2.

**Table 2: Initial data for calculation**

Name of the manufacturer	Generalized indicator of product quality, Q	The reproducibility of the process, Cp	Price, rub
Enterprise №1	0,95	0,12	5434
Enterprise №2	0,97	0,25	5884
Enterprise №3	0,38	0,432	5167
Enterprise №4	0,79	2,7	5735
Enterprise №5	0,67	0,39	5900
Enterprise №6	0,94	0,35	5580

### 3 Results and discussion

Results of calculation of the generalized criterion of competitiveness of production are given in table 3.

**Table 3: Results of calculation of the generalized criterion of quality**

Name of the manufacturer	Values of coefficients of ponderability			
	$\alpha_1 = 0,25$	$\alpha_1 = 0,25$	$\alpha_1 = 0,5$	$\alpha_1 = 0,33$
	$\alpha_2 = 0,25$	$\alpha_2 = 0,5$	$\alpha_2 = 0,25$	$\alpha_2 = 0,33$
	$\alpha_3 = 0,5$	$\alpha_3 = 0,25$	$\alpha_3 = 0,25$	$\alpha_3 = 0,33$
Enterprise №1	0,731	0,505	0,739	0,658
Enterprise №2	0,712	0,516	0,743	0,657
Enterprise №3	0,638	0,428	0,486	0,517
Enterprise №4	0,904	0,929	0,882	0,905
Enterprise №5	0,647	0,464	0,600	0,570
Enterprise №6	0,738	0,539	0,748	0,675

## 4 Conclusion

By results of calculation of the generalized criterion it is visible that in the wide range of values of coefficients of ponderability the most competitive is production of the enterprise № 4 that is caused by high value of an index of reproducibility of technological process at the acceptable level of the generalized indicator of quality of production and the price.

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**Received: January 28, 2015; Published: February 23, 2015**