LIGHT INDUSTRY

COMPREHENSIVE EVALUATION OF THE QUALITY LEVEL OF INDUSTRIAL PRODUCTION

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The European vector of the development of Ukrainian economy set the task for the domestic industrial enterprises of significantly improving the products quality with minimum additional funds and labor costs. It is impossible to solve this task without developing an effective quality management system, based primarily on scientific methods for the integrated evaluation of product quality and computer software. Integrated evaluation of the product quality level includes [1]:

- selection of the nomenclature of properties or, so-called, single indicators that ultimately determine the quality of the product;
- evaluation of the significance of single quality indicators;
- determination by one of the known methods (experimental, calculation, expert, organoleptic, sociological) of numerical values of single quality indicators and transfer of the latter into dimensionless indicators;
- calculation of a complex (generalized) indicator of product quality, which is a function of single indicators.

In the general case, the complex quality index $\theta_к(x,\alpha)$ can be represented in the form of a functional

$$\theta_к(x, \alpha) = f(x_1, x_2,..., x_n, \alpha_1, \alpha_2,..., \alpha_n), \qquad (1)$$

where $x^т = \{x_1, x_2,..., x_n\}$ – row vector of dimensionless unit quality indicators; $\alpha^т = \{\alpha_1, \alpha_2,..., \alpha_n\}$ – row vector of weighting coefficients that determine the weight of the corresponding properties of the sewing products and satisfying the condition $\sum_{i=1}^{n}\alpha_i = 1$; n – number of product properties used to evaluate its quality.

Each of the dimensionless exponents x_i, occurring in (1) is a function of the numerical value a_i of the corresponding unit index quantitatively characterizing the i-th property of the product $x_i = x(a_i)$.

The results of calculating the functional (1) can be used for:

- deciding on the attribution of products variety;
- comparison of different product variants to determine the best one (in terms of quality);
- determination of the nomenclature of product properties, improvement of which will allow to increase its quality to the greatest extent at acceptable additional means and labor costs.

Unfortunately, it is impossible to establish a strict functional dependence of the type (1) for the sewing production since a number of properties of such products (for example, conformity to modern trends of fashion, weariness, irreparability, color strength, appearance, etc.) are subject to strict quantitative assessment. Therefore, in practice, this dependence should be formed in a subjective way, considering that in accordance with the theory of optimal control [2], the dependence (1) must necessarily be a monotonous function (increasing or decreasing) of each of its arguments. Most often functional (1) is represented as one of the following types:

$$\theta\kappa_1(x, \alpha) = \sqrt[n]{\prod_{i=1}^{n}\left[\varphi_1(x_i)\right]^{\alpha_i}}; \tag{2}$$

$$\theta\kappa_2(x, \alpha) = \frac{1}{\sum_{i=1}^{n}\frac{\alpha_i}{x_i}}; \tag{3}$$

$$\theta\kappa_3(x, \alpha) = \sum_{i=1}^{n}\alpha_i\varphi_3(x_i), \tag{4}$$

where $\varphi(x_i)$ – monotone function of the i-th dimensionless unit quality index.

It is not difficult to show that all three, at first glance, different indicators, can be reduced to one. Using the relation c = exp {ln c}, known from mathematics, we represent the expression (2) as follows

$$\theta\kappa_1(x, \alpha) = \exp\left\{\frac{1}{n}\sum_{i=1}^{n}\alpha_i\varphi_1(x_i)\right\}. \tag{5}$$

It is seen from (5) that the function $\theta\kappa_1(x, \alpha)$ is monotonically related to the function

$$\Psi_1(x, \alpha) = \sum_{i=1}^{n}\alpha_i \cdot \ln\varphi_1(x_i) \tag{6}$$

and therefore, instead of the functional dependence (2), we can use the function $\Psi_1(x, \alpha)$ to evaluate the quality of products. It follows from the comparison of the functionals (4) and (6) that they are completely equivalent for $\varphi_3(x_i) = \ln \varphi_1(x_i)$. Similarly, an equivalent indicator can replace indicator (3) in the evaluation of product quality

$$\Psi_2(x, \alpha) = \sum_{i=1}^{n} \frac{\alpha_i}{x_i}, \qquad (7)$$

coinciding with (4) if $\varphi_3(x_i) = \frac{1}{x_i}$. It should be considered that the function $\Psi_2(x,\alpha)$ is monotonically decreasing with respect to its argument **x** and, for example, the best of the products compared with the exponent (7) is the one for which $\Psi_2(x,\alpha)$ has minimal value.

The choice of the form of the functional dependence of $\varphi(x_i)$ in the exponents (2) and (4) makes it possible to additionally change the weight (significance) of one or another unit index depending on its numerical value. Thus, if $\varphi(x_i)$ is chosen in the form

$$\varphi_i(x_i) = \exp\{-\exp[-x(a_i)]\}, \qquad (8)$$

the weight of those single indicators whose numerical value is less than that of the basic sample of products increases. In the literature, the unit exponent (8) is known as the private desirability index [3].

From the reliability point of view of integrated evaluation results of the products quality, none of the subjective complex indicators has an advantage. The assertion of some authors [1] that the use of the exponent (2) in a number of cases makes it possible to obtain «more correct results» in comparison with the exponent (4) for $\varphi_3(x_i) = x_i$ is incorrect, since permissible values of single indicators x_i are not preliminary specified. The advantages of the exponents (2) and (3) in comparison with (4) for $\varphi_3(x_i) = x_i$ are, as a rule, seemingly insignificant, while the shortcomings of these indicators can be very significant. So, for example, to optimize the indicator (4), with limitations on product cost, labor, etc., well-developed linear programming methods can be used. If the indicator (2) or (3) is used instead of the exponent (4), nonlinear programming methods should be used for optimization, which greatly increases the computational difficulties and, most importantly, does not allow to solve the problem for the general case. Therefore, the fact that indicator (2) has so far been more widely used in evaluation the quality of sewing products [4-6] than indicator (4) is in fact not justified.

Conclusions:

1. From the reliability point of view of integrated evaluation results of the products quality, none of the subjective complex indicators has an advantage.

2. In practice, the advantage should be given to those indicators, usage of which allows to solve a wide range of problems related to product quality management. An example of such indicator is the weighted average indicator with the corresponding limitations.

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ВПЛИВ ТЕХНОЛОГІЙ ЗБИРАННЯ НА ЯКІСНІ ПОКАЗНИКИ ЛУБ'ЯНИХ КУЛЬТУР

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Протягом останніх років на території Україні спостерігається стрімке зростання посівних площ [1], таких луб'яних культур, як технічні коноплі та льон олійний (рис. 1).

У зв'язку з високою вартістю насіннєвого матеріалу дана галузь промисловості в нашій державі вважається високоприбутковою. При цьому, стеблова частина вищезазначених культур практично не переробляється [2]. Але, як свідчить глибокий аналіз літературних джерел, вже в багатьох економічно розвинених країнах світу, технічні коноплі та льон олійний, визнані стратегічно важливою луб'яною сировиною в текстильній, трикотажній,