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PRODUCT QUALITY AND METHODS OF ITS EVALUATION

The article is devoted to the definition of quality as an important economic category that occupies a key place in marketing product policy. It is emphasized that the strategic task of every enterprise today is to achieve high economic efficiency and competitiveness of products. It is noted that quality plays a key role in achieving this goal. It is determined that quality combines a number of product properties which contribute to meeting the needs of the consumer and meet its purpose. It is emphasized that among the factors that affect product quality are production, economic and human ones.

The necessity of production conformity to needs of the consumer is specified. The importance of quality assessment, control of its level, as well as the need to select quality indicators that allow such an assessment, is emphasized. The classification of indicators depending on the properties of products is determined, in particular, single, complex and generalizing indicators are considered. Emphasis is placed on the division of each of the classes into subgroups to be measured or expertly assessed. The main methods that play a key role in assessing product quality, including differential, complex, mixed, statistical ones, are named. The importance of mathematical and statistical methods for assessing the quality characteristics of products is noted. It is indicated that the basis of such methods is the calculation of the utility function, the compliance of product properties to the desired consumer values is considered. It is emphasized that the utility function of the purchased goods is equal to the sum of price and quality characteristics. An example of evaluation of qualitative indicators by the integrated method is considered. Relevant quality indicators which allow such an assessment are selected. The calculation of unit parametric indicators and their comparative analysis with normative and desired values are carried out. The conclusion on the basis of the results of quality assessment is made.

It is emphasized that one of the key tools in assessing product quality is information technologies. It is noted that information technologies provide the implementation of mathematical and statistical models. It is emphasized that one of the key means of improving quality is investing in research and development, i.e. improving of production processes.

Keywords: *quality, competitiveness, products, goods, consumer, quality assessment, method, quality indicators, utility function, integrated quality indicator, information technologies.*

At the present stage of market economy development, the quality of products and services is an important indicator of the company's product policy. It affects the level of competitiveness of products, as well as the successful operation of any enterprise.

Quality products are a key factor in increasing human living standards, economic, social and environmental security. It helps to ensure the competitiveness of the enterprise and its economic stability.

Combining a set of product properties, quality requires constant monitoring, measurement and analysis of the results. Such quality control of products creates the need for quantitative assessment of its indicators.

The development of modern science has allowed us to develop a system of methods for assessing quality. The basis of all methods is the comparison of quality indicators with basic, normative indicators.

Mathematical and statistical methods play an important role in quality assessment. With their help it is possible to carry out timely and full control. Information technology is an important tool in quality assessment. They contribute to the accuracy and efficiency in the calculation and analysis of evaluation results.

Based on the results of the analysis of product quality level assessments, appropriate management decisions are made and implemented.

Analysis of recent research and publications. More and more specialists are dealing with the issue of research and quality analysis, as well as its evaluation. Significant contributions to theoretical research, development of methods for assessing product quality, as well as evaluation were made by such scientists as: S. M. Bezrodna [1], O. O. Bilenchuk [3], S. M. Bondarenko [2], I. V. Burachek [3], E. Yu. Vershigora [4], O. O. Getman [5], O. I. Zorina [6], V. O. Morokhova [7], V. O. Sivolovskaya [1], D. V. Smolych [7], O. M. Sumets [8], O. E. Somova [8], E. F. Pelikhov [8], G. I. Tsilyurik [9], V. M. Shapoval [5] and others.

However, the change in quality, which depends on the constant change of consumer needs requires further study, measurement and recommendations on the methods of its evaluation.

The aim of the article is to generalize the theoretical and practical principles of the category of product quality and study the methods of its evaluation.

Presentation of the main material of the study. Modern development of production, intensification of marketing processes require each company to constantly analyze their capabilities and the capabilities of their competitors. That is, the strategic task of every enterprise today is to achieve high economic efficiency and competitiveness. An important element of this strategy is product competitiveness.

"Product competitiveness is the ability of the enterprise to create, produce and sell goods and services, price and non-price qualities of which are more attractive than similar products of competitors" [3, p. 289].

Quality plays a key role in product competitiveness. "Quality is the set of properties and characteristics of a product that give it the ability to meet established or anticipated needs. The established needs are fixed in legal norms, standards, orders, agreements, technical conditions of deliveries and other documents. Expected needs are those expectations that the consumer usually does not formulate specifically, but refers to stable wishes" [9, p. 43].

That is, each product must have properties that meet the needs and demands of consumers. Improved properties require increased costs. "High quality is the most expensive, but practice shows that high quality is not always associated with increased costs for the manufacturer. For example, investing significant funds in research and development can result in improved product quality, while improving production processes – a significant reduction in product cost. This has been demonstrated by Japan and the highly developed countries of the world for a wide range of mass-produced goods – computers, household appliances and household appliances. In recent years, the quality of these products has improved markedly, and the cost has decreased" [7, p. 63].

Such an important role of quality in the production and consumption of products requires constant analysis, monitoring and evaluation. To conduct a full assessment of quality, it is necessary to choose a system of indicators. Quality indicators are the characteristics of the properties of the product, which indicate the degree of satisfaction of consumer needs. Since they characterize a different number of product properties, they can be divided into:

- single (characterize individual properties);
- complex (characterize a group of properties);
- generalizing (characterize the whole set of products).

Evaluating the quality of products, they determine its absolute, relative, future and optimal levels. The absolute level is carried out by calculating the indicators. The relative level requires a comparison of absolute indicators of product quality with the corresponding indicators-analogues. Promising level provides a level of product quality in the future.

To assess the quality using methods that can be classified as: differential, complex, mixed, statistical. (Figure 1).

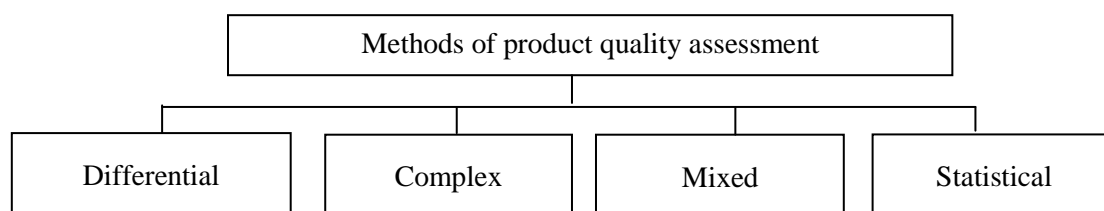


Figure 1 – Methods of product quality assessment

Source: developed by the authors on the materials [1, 2]

"Differential method of assessing product quality is based on the use of individual indicators of its quality. The complex method of product quality assessment is based on the use of complex quality indicators. The mixed method synthesizes single and complex quality indicators. Statistical method is a method that determines the quality of products using the rules of mathematical statistics" [1, p. 137]. Each of these methods has different approaches and ways of implementation.

To assess the competitiveness of products, you can use the utility function, which indicates the compliance of product properties with the values that the consumer wants to get. In this case, the utility function of the purchased goods is equal to the sum of the characteristics of value (price) and quality (quality). That is, quality is one of the main indicators in determining the competitiveness of products.

In the further study of qualitative characteristics, ie, assessment of product quality, quality indicators should be considered. The concept of quality includes a set of product characteristics: availability, supply, technical and economic characteristics, design, reliability, efficiency of consumption and operation, maintainability, degree of environmental friendliness, etc. These characteristics the product acquires (and manifests) during its creation, implementation and consumption or exploitation" [6, p. 34]. Depending on the type, purpose and specifics of the product, they may be different. For example, in some products you can select such groups of indicators as design, image, performance, technical characteristics (Figure 2):

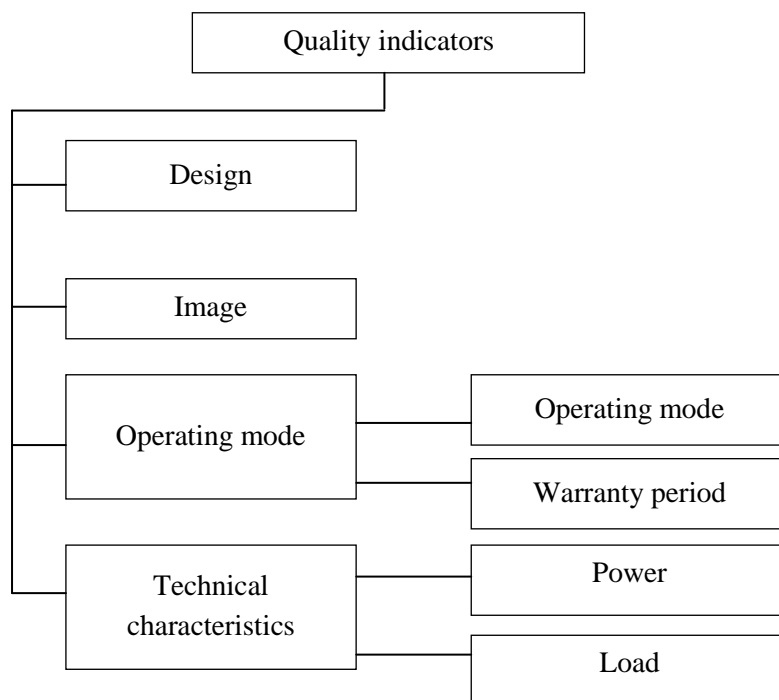


Figure 2 – Quality indicators

Source: developed by the authors on the materials [5, 4]

To assess quality, these indicators must be quantified. These quantitative characteristics and weights can be determined through expert assessments or consumer surveys.

An integrated quality indicator that characterizes the product's compliance with consumer requirements can be determined by the formula

$$Q = \sum_{k=1}^K v_k \sum_{i=1}^I v_i w_i, \quad (1)$$

where Q is the integrated quality indicator;

k – product attribute;

K – the number of attributes;

i – indicator;

I – the number of indicators;

v_k – weight of the k -th attribute;

v_i – weight of the i -th attribute;

w_i – is a single parametric indicator.

If consumers are interested in increasing the value of the indicator, the unit parametric indicator is calculated by the formula:

$$w_i = \frac{L_i - L_i^{\min}}{\hat{L}_i - L_i^{\min}}, \quad (2)$$

where L_i^{\min} – the minimum value of the i -th quality indicator that allows the product to market;

\hat{L}_i – the value of the i -th quality indicator that meets the needs of the consumer, ie the desired value;

L_i – the value of the i -th indicator of product quality, the real value.

The following condition must be met:

$$L_i \geq L_i^{\min}. \quad (3)$$

If consumers are interested in reducing the value of the indicator, it is calculated by the formula:

$$w_i = \frac{L_i^{\max} - L_i}{L_i^{\max} - \hat{L}_i}, \quad (4)$$

where L_i^{\min} – the minimum value of the qualitative i -th quality indicator that allows the product to market;

\hat{L}_i – the value of the i -th quality indicator that meets the needs of the consumer, ie the desired value;

L_i – the value of the i -th indicator of product quality, the real value.

The following condition must be met:

$$L_i \leq L_i^{\max}. \quad (5)$$

There is a group of indicators for which both deviations (3) and (5) are fulfilled. Then this condition can be written as follows:

$$P_i^{\min} \leq P_i \leq P_i^{\max}. \quad (6)$$

In this case, formula (2) is valid for the left part of the inequality, and formula (4) is valid for the right part.

To calculate the integrated quality indicator of homogeneous products it is necessary to have the values of individual quality indicators desired by the consumer and their regulatory values (Table 1).

Table 1 – **Normative and desirable values of individual quality indicators**

Unit quality indicators	Units of measurement	Value desired by the consumer	Normative value
Image	part.	250	700
Design	part.	0,9	0,6
Operating mode	hours/day	0,8	0,5
Warranty period	years	16	8
Load	M ³	100	100-200
Power	pieces/human	150	100-160

Source: developed by the authors on the materials [5, 4]

Table 2 shows the actual values of unit quality indicators for the studied products P1-P2.

Table 2 – **Real values of unit quality indicators for researched goods**

Single quality indicators	P1	P2	P3	P4	P5
Image	0,7	0,7	700	500	430
Design	0,9	0,8	0,9	0,8	0,8
Operating mode	8	8	0,8	0,7	0,9
Warranty period	2	2	14	16	20
Load	115	150	180	170	160
Power	100	110	140	150	110

Source: developed by the authors on the materials [5, 8]

After calculating the unit parametric indicators according to formulas (2) and (4) and taking into account the weight of each of the product attributes, we obtain an integrated value of the quality indicator for the product under study (Table 3).

Table 3 – The value of integrated quality indicators for the studied products

Characteristics name	P1	P2	P3	P4	P5
Integral quality indicator, Q	0,72	0,70	0,80	0,54	0,62

Source: developed by the authors on the materials [5, 4]

A visual image of the integrated quality indicator for the studied goods is shown on the polygon of the quality assessment of goods (Figure 3).

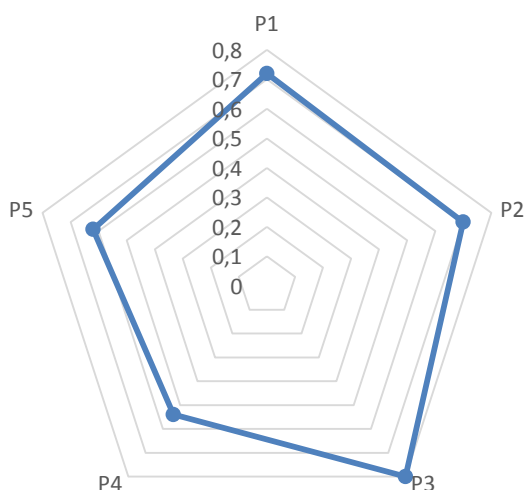


Figure 3 – Polygon of product quality assessment

Source: developed by the authors

As can be seen from the figure, the highest quality is product P3 with a quality index $Q = 0,80$. And the lowest quality is product P4 with a quality index $Q = 0,54$. The other three products took an average position compared to competing products.

Quality assessment is accompanied by the creation of mathematical models and complex calculations. Therefore, an indispensable tool for quality assessment is information technology, which can be used to implement these models and perform analysis.

Conclusions. Thus, quality is an important economic category that combines the properties of products that can meet the consumer needs. Quality affects the goods demand and is a direct factor in its increase. Therefore, quality products themselves are an incentive to increase production, as well as to sell it at higher prices. This helps to increase profits and, consequently, the stability and success of the enterprise.

Product quality indicator plays an important role in its competitiveness and requires thorough analysis and evaluation. Different methods are used to assess quality. One of them is an integrated method based on utility functions.

At the present stage of economic development there are radical changes in science and technology, which has a positive effect on improving the role of quality in achieving a high level of competitiveness. High quality products ensure the growth of economic and social security of the enterprise and affect its positive image.

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ЯКІСТЬ ПРОДУКЦІЇ ТА МЕТОДИ ЇЇ ОЦІНКИ

Статтю присвячено визначенню якості як важливої економічної категорії, що займає ключове місце в маркетинговій товарній політиці. Наголошено, що стратегічним завданням кожного підприємства сьогодні є досягнення високої економічної ефективності та конкурентоспроможності продукції. Відзначено, що ключову роль на шляху до цієї мети відіграє якість. Визначено, що якість поєднує в собі сукупність властивостей продукції, які сприяють задоволенню потреб споживача та відповідають її призначенню. Наголошено, що серед факторів, які впливають на якість продукції, можна виділити виробничі, економічні та людські.

Вказано на необхідність відповідності продукції потребам споживача. Наголошено на важливості оцінки якості, контролю її рівня, а також на необхідності підбору показників якості, що дозволяють провести таку оцінку. Визначено класифікацію показників залежно від властивостей продукції, зокрема розглянуто одиничні, комплексні та узагальнюючі показники. Наголошено на поділі кожного з класів на підгрупи, що підлягають вимірюванню або експертній оцінці. Названо основні методи, які відіграють ключову роль в оцінці якості продукції, зокрема диференційний, комплексний, змішаний, статистичний. Відзначено важливість математико-статистичних методів оцінки якісних характеристик продукції. Вказано, що в основу таких методів покладено розрахунок функції корисності, розглядається відповідність властивостей продукції бажаним споживачеві значенням. Наголошено, що функція корисності придбаного товару дорівнює сумі цінкових та якісних характеристик. Розглянуто приклад оцінки якісних показників інтегральним методом. Підібрано відповідні показники якості, які дозволили провести таку оцінку. Проведено розрахунок одиничних параметричних показників та порівняльний аналіз їх з нормативними та бажаними значеннями. Зроблено висновок на основі результатів оцінки якості.

Наголошено, що одним із ключових засобів при проведенні оцінки якості продукції є інформаційні технології. Відзначено, що інформаційні технології забезпечують реалізацію математико-статистичних моделей. Наголошено, що також одним з ключових засобів покращення якості є вкладання коштів у наукові дослідження та новітні розробки, тобто вдосконалення виробничих процесів.

Ключові слова: *якість, конкурентоспроможність, продукція, товар, споживач, оцінка якості, метод, показники якості, функція корисності, інтегрований показник якості, інформаційні технології.*

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