DOI: https://doi.org/10.30525/2256-0742/2025-11-2-352-360

EVALUATION OF PRODUCT QUALITY: INDICATORS AND METHODS

Svitlana Gutkevych[1], Yurii Safonov[2], Oleh Holovko[3]

Abstract. The present article focuses on the economic approach to product quality management, which seeks to achieve an economic effect by comparing costs and benefits. The article evaluates the effectiveness and efficiency of product quality management based on market, financial, social, and other factors. A range of approaches to quality management efficiency are identified, including economic, scientific and technical, resource, social, and environmental. Indicators are utilised to evaluate the efficacy of the product quality management process, and these indicators may be absolute or relative. The selection of quality indicators is contingent upon the unique characteristics of the product or service in question, with consideration given to both consumer requirements and company policy. The article further proposes a classification scheme of product quality indicators, encompassing the manner of expression, the scope of application, the number of assessed properties, and the stages of determining indicators. The article goes on to discuss the particular complexities involved in evaluating the effectiveness of activities in the printing industry. The quality of the publication produced by publishing and printing enterprises is the result of the editorial process, the publishing processing and the polygraphic execution. The article proposes a set of quality indicators for printing enterprises, which includes product and service quality. A variety of methods and indicators are employed to evaluate the quality of manufactured products, including the absolute, relative, prospective, and optimal levels of quality. The article under discussion herein sets forth a range of approaches to the evaluation of costs associated with quality assurance, proposing the utilisation of a system of indicators for the purpose of evaluating quality. The proposed methods encompass the differential, complex, and mixed approach. The article proposes evaluating the effectiveness of quality control and the organisational and technological readiness of the enterprise, as well as its solvency, personnel support and information support, in order to assess the quality of physical printed products and printing services provided by the company. It also suggests evaluating management effectiveness at three levels: the manufacturing enterprise; the customer of printing services; and the end user of printed products. The article under discussion herein sets out to explore the use of rating systems in the evaluation of the effectiveness of product quality management. In this regard, the balanced scorecard system (BSS) is presented as an alternative to traditional financial analytical evaluation indicators.

Keywords: economic, product quality management, efficiency, printing industry, quality indicators, rating systems, balanced scorecard, relative.

JEL Classification: O10, H21

1. Introduction

From an economic perspective, the objective of product quality management is to generate an economic effect, which is defined as the achieved outcome in monetary, material or social terms. For a business entity, the expediency of product quality management measures is determined by comparing the obtained effect and the costs necessary to obtain it, and is evaluated according to two criteria:

– Effectiveness is characterised by the achievement of market, financial and social results, which are expressed in terms of revenue, income, satisfaction of needs, and material and social benefits.

[1] National University of Food Technologies, Ukraine *(corresponding author)*
E-mail: gutkevych@ukr.net
ORCID: https://orcid.org/0000-0003-2645-4011
[2] State Scientific Institution "Institute of Education Content Modernization", Ukraine
ORCID: https://orcid.org/0000-0001-5623-1965
[3] Black Sea Research Institute of Economy and Innovation, Ukraine
ORCID: https://orcid.org/0000-0003-0841-4534

– Efficiency represents the relative effectiveness of an activity, process, operation or project, defined as the ratio of the outcome to the cost of achieving it.

2. Presenting Main Material

As posited by certain economists (Kopnov, Rogov, 2008), a multi-faceted typology of quality management efficiency is posited, predicated on the outcomes of such management systems. This typology comprises the following types: economic, scientific and technical, resource, social and environmental (see Table 1). Each of these can be evaluated at two levels: firstly, the level of product quality assessment as a result of the production process; and secondly, the level of general enterprise management. The effectiveness of the product quality management process is characterised by a system of indicators that determine the quantity and quality of the parameters of this process. The concept of economic efficiency can be operationalised through the utilisation of various indicators, which are categorised into absolute and relative based on their operationalisation.

In scientific works (Bart, Efimov, 2006), domestic and foreign scientists have proposed different approaches to the formation of a set of quality indicators, but they clearly define that the choice of indicators depends on the individual characteristics of the product or service, taking into account the purpose and conditions of their use, consumer requirements and the company's policy in the field of qualities'. In the course of the research, a range of systems for evaluating the efficiency of product quality management were considered, as well as the methods by which they are evaluated. It was determined that these systems can be divided into two groups:

Group I: indicators of product quality.

P group: indicators of the effectiveness of the management process (actions of the management system of forming and ensuring the quality of products).

As the analytical review showed, many scientific works by economists (Veksler, 2008; Ilenkova, Ilenkova, Mkhitarian, 2003; Markina, Burdelna, 2011; Lepiyko, 2011; Momot, 2007; Feigenbaum, 1991) devoted to product management contain consideration of the first group, and product quality indicators are classified according to various features depending on the assessment goals: the way of expression, scope of application, number of assessed properties, stages of determining indicators, etc. The generalised classification scheme of product quality indicators is presented in Figure 1.

The peculiarities of evaluating the effectiveness of activities in the printing industry are related to the object of their activity. The outcome of the publishing and printing enterprises' activities is a publication that has undergone editorial and publishing processing, and has been produced by printing, embossing or other methods. It contains information intended for distribution and meets the requirements of state standards and other regulatory legal acts regarding publishing design, printing and technical execution (Verkhovna Rada of Ukraine). The quality of the content of the work and its editorial and publishing processing, taking into account the target and readership, form the internal quality of the publication. The external quality of the publication is determined during the process of polygraphic execution, or the provision of polygraphic services. According to the nomenclature of industrial products, these services belong to the category of production services or works. This is precisely what determines the duality of the products of printing enterprises as:

– Publishing services by typographic method;
– material products with a certain design, features and parameters, the embodied result of intellectual work.

The quality of products is determined by the combination of the quality of the technical means employed and other material objects, as well as the quality of the service offered to the customer. This can be expressed in signs and parameters: a product

Table 1
Types of product quality management effectiveness

Effectiveness types	Characteristics
Economic	Calculate the value ratio of all types of results and costs caused by quality management measures. Internal efficiency is expressed through reduced expenditure and increased productivity, while external efficiency is expressed through increased income and market share.
Motor and technical	Associated with the introduction of new technologies and the production of high-quality products based on scientific and technical advances.
Resource	Reflects the impact of quality management on the production and consumption volumes of certain types of resources.
Social	It is based on the social outcomes of product quality management, particularly the growth of social capital and the levels of trust and stability.
Ecologic	It takes into account the positive or negative environmental impact of quality management measures.

Source: supplemented based on data

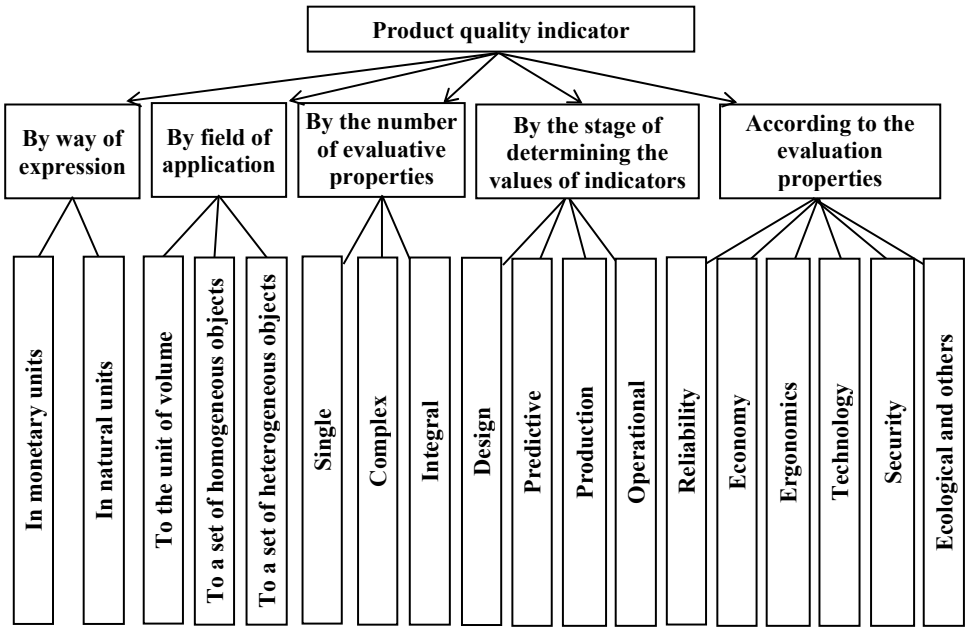

Figure 1. Classification of product quality indicators

Source: supplemented based on data

sign reflects qualitative or quantitative characteristics of its properties, and a single parameter can only reflect quantitative characteristics. In this regard, the objective is to determine the quality of printing products as an overall assessment of the quality of the final result of the activity (product) and the quality of customer service. The nomenclature of the main quality indicators of printed publications, as the final result of the activity of printing enterprises, is defined by GOST 4.482-87 System of product quality indicators. Publishing and printing design and printing execution. Nomenclature of indicators. These indicators are included in the technical specifications and product requirements, thereby enabling the assessment of the technical level of product quality.

A thorough analytical review of the extant regulatory documentation (The System for the Development and Delivery of Products to Production, 2000) and approaches to determining service quality indicators (Lepiyko, et al., 2011) was undertaken to inform the formation of the following product quality indicators of printing enterprises (Figure 2). These indicators are unidimensional in nature, in the sense that they are designed to characterise one of the properties of the products.

The analysis of changes in the quantitative characteristics of individual unit indicators is complemented by the analysis of the volume of sales per citizen of the country, etc. It is imperative to allocate a substantial amount of attention to the evaluation of service quality, as this provides insight into the culture of communication between company employees and customers, as well as the adherence to the stipulated terms of order fulfilment. The quality level of a certain product is determined by the specified quality indicators, which are understood as a quantitative characteristic of the degree of suitability of a particular type of product to meet a specific demand for it in comparison with the corresponding basic indicators under fixed conditions of consumption. The assessment of product quality encompasses the determination of its absolute, relative, prospective and optimal level.

The absolute level of quality is determined by calculating selected indicators of product quality without comparing them with the corresponding indicators of similar products. The definition is inadequate insofar as the absolute values of quality indicators do not reflect the degree of compliance with contemporary requirements. Consequently, the relative level of certain types of manufactured products is determined by comparing its indicators with the absolute quality indicators of the best similar domestic and foreign samples of products.

The level of product quality is increasing under the influence of scientific and technological progress and consumer demands. Accordingly, some scientists propose assessing the prospective level of quality, which takes into account the pace of scientific and technological growth. Given the emergence of new products and labour practices, it is important to determine the optimal quality level, i.e., the level at which the total public cost of producing and using products would be minimal under certain consumption conditions. In order to provide a comprehensive evaluation of the quality level of all products produced,

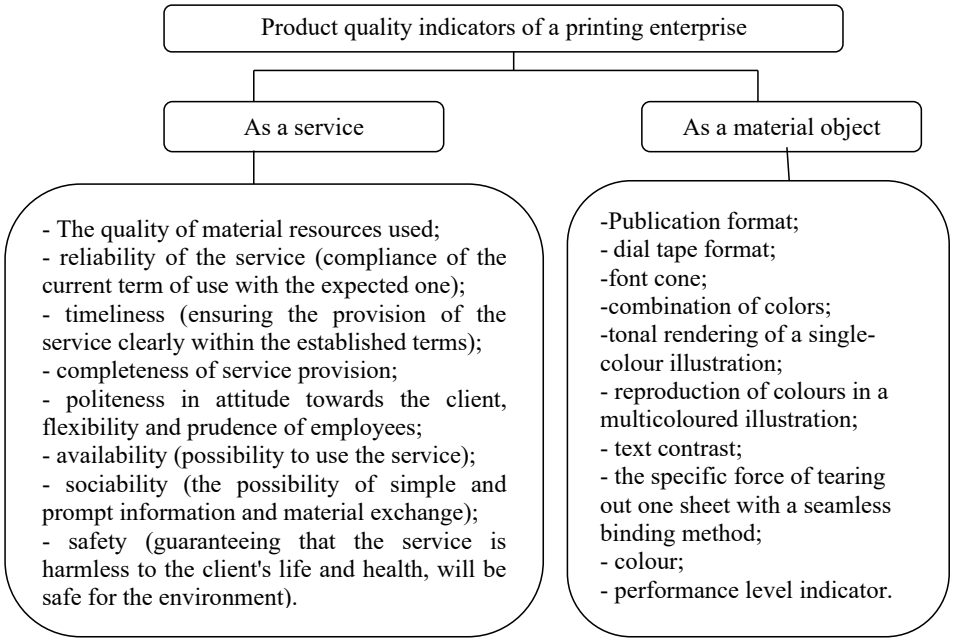

Figure 2. Product quality indicators of a printing enterprise

Source: supplemented based on data

printing enterprises employ a range of general indicators. These indicators encompass the following: the proportion of new products in the total output; the proportion of products in the highest quality category; the proportion of certified and non-certified products; the proportion of certified products; and the proportion of exported products.

The integral indicator of the level of product quality is calculated as the ratio of the total beneficial effect from the production and sale of products to the total costs necessary for its achievement, according to the formula:

$$I_{\text{я}} = \frac{\text{Å}_t}{\text{B}_t}$$

A_t – cost estimate of the effect of the production and sale of products of the established quality for the calculation period *t*;

B_t – is the cost estimate of costs for the production and sale of products of the established quality for the calculation period *t* (Gutkevych, Haydutskyi, 2022).

In order to obtain an objective assessment of product quality, it is necessary to take into account the cost estimate that made it possible to obtain results. As posited by several scientists (Feigenbaum, 1991), it is considered expedient, within the modern context, to determine and estimate the costs associated with the formation and assurance of product quality. This can be achieved through two approaches: firstly, as proposed by A. Feigenbaum and J. Juran; and secondly, as outlined by F. Crosby. According to the first approach, costs are divided into:

– Expenses for the prevention of defects are defined as expenses that are incurred in order to prevent the very possibility of defects arising. These expenses may also be incurred in order to reduce or completely eliminate the possibility of defects or losses.

– The costs of control are the costs of determining and confirming the existing or achieved quality level.

– Losses from defects include the costs of eliminating defects and achieving the appropriate level of quality, as well as the costs of complaints.

The following are highlighted when combining the first two types of costs: 1) compliance costs: costs associated with ensuring the production of quality products; 2) nonconformity costs (losses associated with internal and external defects). The approach to grouping quality costs is determined by management and is often based on the company's accounting policy.

In certain scientific works, in addition to individual and complex ones, indirect indicators of product quality are distinguished, including, but not limited to: fines for the production of products of inappropriate quality; volume and proportion of defective products; losses due to defects, etc. Nevertheless, it is generally accepted that the quality of products cannot be characterised by a single indicator. Consequently, a system of indicators is employed, with a number of methods being utilised to calculate them. The analytical approach to the consideration of methodological recommendations for assessing the level of product quality made it possible to single out two main areas of assessment: homogeneous and heterogeneous products. Printed products in material form are homogeneous; therefore, it is proposed to evaluate their quality level by such methods as differential, complex and mixed.

The differential method is based on determining individual quality indicators and evaluating their current values in comparison with baseline or reference values. The limitations of the differential method are the complexity of making decisions based on the values of many individual product quality indicators. The authors propose using a comprehensive method for assessing product quality, which involves calculating a comprehensive (generalised) weighted average indicator.

These indicators can be utilised to evaluate the quality of both physical printed products and printing services by specialists within the printing industry. In the theoretical framework of management, the quality of a product is not solely determined by its inherent characteristics; it is also influenced by the efficacy of the management system in place. The influence of the management subject can be evaluated by the quality of management decisions that are consistently adopted, contributing to the formation and provision of product quality, as well as the effective utilisation of resources necessary for this process. That is, product quality is the result of a management decision, which can be evaluated in the following directions:

– Process result (percentage of plan implementation, market share, share of products of inappropriate quality in the total cost, growth rate of production volumes, etc.);
– the quality of the management structure (the number and completeness of performed management functions);
– the quality of resource provision.

The following indicators are proposed as a basis for the evaluation of each direction. The evaluation of the organisational and technological readiness of the enterprise, as the primary indicator, is determined on the basis of an analysis of the enterprise's production capabilities to produce products of the established assortment and quality, and the provision of the enterprise with basic means. The second indicator, which characterises the flexibility of the capital structure of the enterprise and its solvency, involves an analysis aimed at determining the possibility of the enterprise financing its activities on an expanded basis and maintaining its solvency, making payments on time. The third indicator is concerned with the assessment of staffing. This involves the study of the professional and qualification levels of the company's employees, the level of labour utilisation, staff turnover and the degree of job satisfaction.

This indicator measures the effectiveness of quality control at all stages of the production process. It establishes clear norms and conditions for activities and interactions with suppliers, customers, and so on. At the same time, it takes into account employees' compliance with labour and technological discipline.

Management decisions are based on information support, which is evaluated according to the fifth indicator. The company studies the completeness, availability, correctness, time effectiveness, reproducibility and security of the information necessary for management decisions. Each of the above generalised indicators is the sum of the evaluations of the analytical indicators, and their relationship and interdependence are shown in Figure 3.

This scheme posits that research is conducted with the objective of ascertaining the optimal value of each indicator. To this end, the indicators are converted to a scale of values ranging from 0 to 1, with 1 representing the value of the indicator closest to the optimal value and 0 representing the value of the indicator that is the least close to the optimal value.

The proposed general indicator of the quality of activity is limited in its application, in that it takes into account the results of the assessment only at the enterprise. However, a number of scientists posit that the criteria for the social assessment of quality management are the degree of satisfaction of customers' needs and requirements. Therefore, the assessment of management effectiveness should be carried out at three levels: the manufacturing enterprise, the customer of printing services (in accordance with the requirements of regulatory and internal documentation, personal perception of quality) and the end user of printed products (personal perception of quality).

The objective of this study is to ascertain the target value and the degree of satisfaction of the customer's requirements by employing the scoring method. This method entails the allocation of an expert or consumer score in points to each technical and economic parameter of the product. Subsequently, the general technical and economic level of the product is evaluated through a specialised method, namely an integral evaluation of its quality. The study of customer satisfaction has been demonstrated to facilitate the enhancement of product characteristics and the augmentation of service quality. Furthermore, it has been shown to contribute to the consolidation of the company's competitive position within the market, as well as the establishment of long-term, mutually beneficial relationships with customers.

The efficiency of printing companies is subject to change over time. The evaluation of the effectiveness of product quality management is achieved through the implementation of a rating system, which involves the construction of a rating of enterprises based on calculated metrics. This enables the company to assess its competitive advantages compared to its competitors. The sequence of stages carried out in the process of building the rating is presented in Figure 4.

When evaluating, three types of ratings can be distinguished:

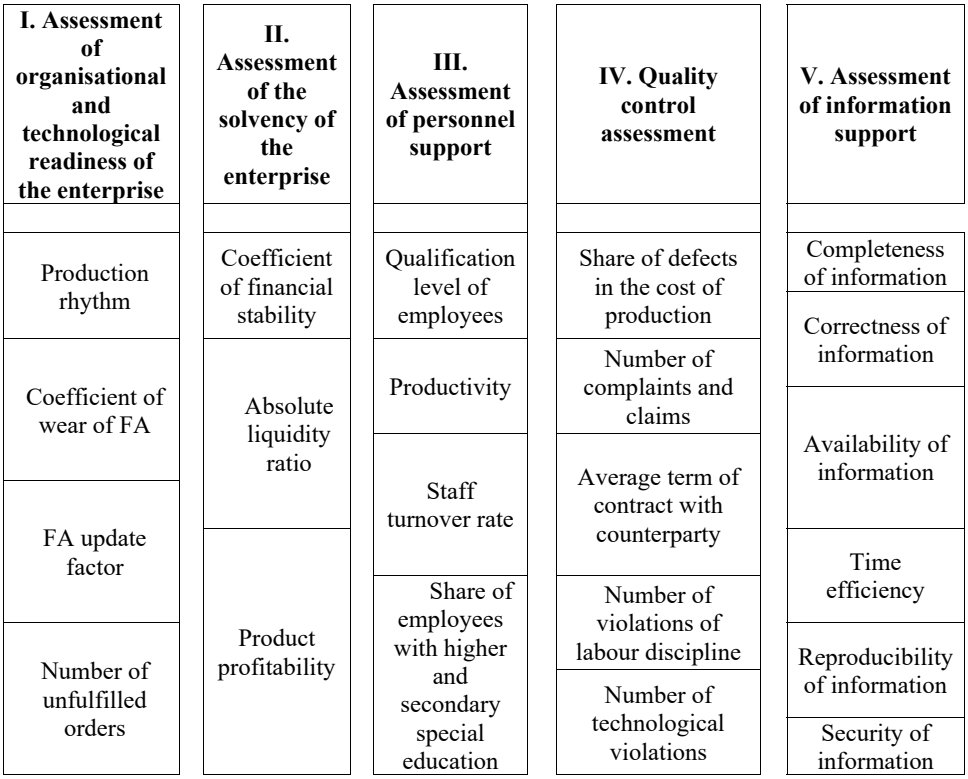

Figure 3. Performance indicators of quality management

Source: supplemented based on data

– According to the indicator of the quality of the enterprise's activity;
– according to the satisfaction ratio of customers' requirements and expectations;
– according to the general indicator of the effectiveness of product quality management.

The rating system enables specialists within the management apparatus to make more informed management decisions, based on data from both internal sources of information and independent external assessments.

Modern systems of analytical indicators provide a structure for evaluating the activity of enterprises within the context of management systems. On the basis of these systems, enterprises are able to distribute resources, manage personnel, collect and process information, and improve management processes. The objective of the study was to explore the possibility of obtaining generalising conclusions, developing and making strategic decisions regarding product quality management. This necessitated the development and application of integral evaluation indicators based on indicators compiled into a system. The purpose of this was to provide the most complete and general assessment of the effectiveness of product quality management not only in the enterprise as a whole, but also in individual functional areas.

The balanced scorecard system (BSS) emerged as an alternative to the system of financial analytical evaluation indicators calculated based on statistical reporting data. The latter usually does not fully reflect reliable information, has a static character, and does not meet the goals of strategic management of the enterprise. Following a thorough analytical review, this paper summarises the main advantages and limitations in the application of approaches to the formation of a balanced system of indicators proposed by various scientists. These approaches include: the balanced system of indicators of Kaplan and Norton (1992), the Lorenz Meisel system (1999), K. McNair's efficiency pyramid, R. Lancha, K. Cross (2000), EP^{2}M systems by K. Adams and P. Roberts (1993), matrices of factors affecting Keegan's efficiency, and so forth (Table 2).

The evaluation is based on the following criteria: scope of application, adaptability and flexibility, time orientation, feedback mechanisms, risk of incorrect indicator selection, and overall efficiency.

– BSS Kaplan-Norton. Applicable to organisations of various scales and sectors of activity. The system is easily adaptable and provides analysis based on past, present, and future data. However, there

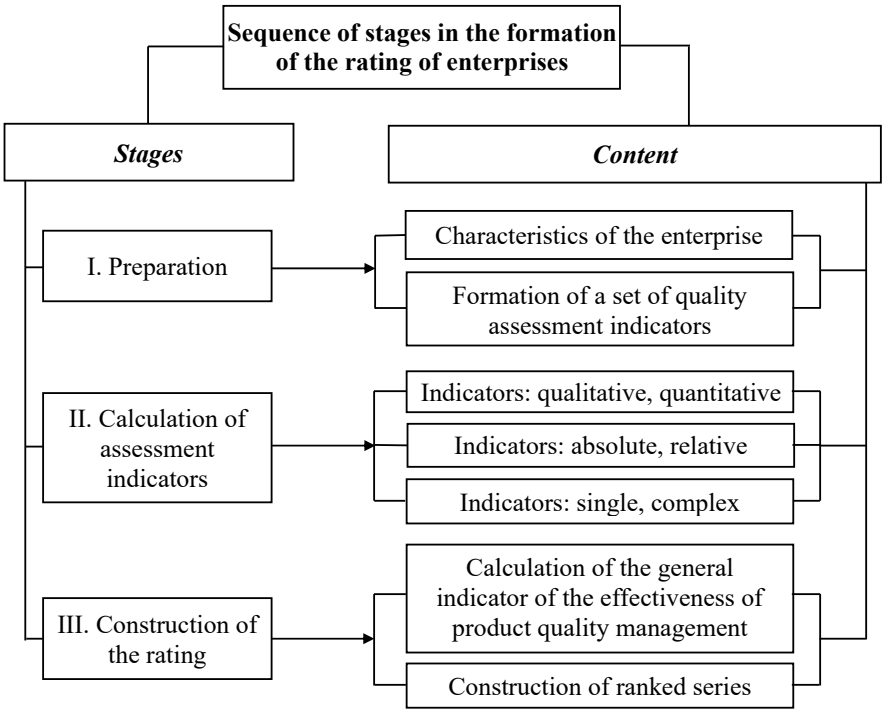

Figure 4. The sequence of stages of building a rating of enterprises

Source: supplemented based on data

Table 2

Comparative analysis of approaches to the formation of a balanced system of indicators

Criteria	Application scope	Adaptability and flexibility	Time limits	Feedback	Risks of choosing KPI
BSS Kaplan-Norton	Different scale and spheres of activity	Easily adaptable system	Analysis of past, present and future data		There is a high risk of incorrect selection of indicators or determination of their relationships
BSS Meisel	For the service sector, banks, financial institutions	Easily adaptable system		Present	
BSS with EVA	Preferred focus on the service sector	Fairly adaptive	Analysis of current data	Depending on the objective function	Moderate
Pyramid of effectiveness	Banks, small production	Inflexible model	Analysis of past results and prospects	Present	Most indicators are deterministic
EP^{2}M	Banks	Moderately flexible model		Missing	High

Source: supplemented based on data

is a high risk of incorrect selection of indicators or misinterpretation of their interrelationships.

– BSS Meisel. An easily adaptable system primarily designed for the service sector, banks, and financial institutions.

– BSS with EVA. Predominantly used in the service sector. It is fairly adaptable and focuses on the analysis of current data. The level of risk depends on the target function and is generally considered moderate.

– Pyramid of efficiency. Applied mainly in banks and small-scale production. This is an inflexible model focused on the analysis of past results and future projections. Most of its indicators are deterministic.

– EP2M. Moderately flexible model.

Following a comparative analysis, it was determined that the Kaplan-Norton balanced system of indicators has potential application at printing enterprises. This is due to the fact that it reflects indicators characterising both past performance results and current data, and is easily adapted.

The main purpose of the BSS is to reflect the enterprise's mission, goals and development strategy

in a system of interrelated quantitative and qualitative indicators. These indicators are determined through financial results and other non-monetary indicators for specific activity areas. To this end, the company sets strategic and mutually agreed tactical goals, which it must achieve within three to five years across four main areas: financial performance, customer interaction, internal processes and personnel training and development.

In accordance with the BSS methodology, the existence of a cause-and-effect relationship between the goals of the four components is to be expected. Indicators are selected and substantiated for each objective, and their specific values are established, which characterise its achievement, and which are entered into the so-called scorecard, the general form of which is given in Table 3.

The chart of accounts is a document that reflects the relationship between the formulation of the strategy and its implementation, where there is a direct connection between strategic, tactical and operational management. It reflects the process of transformation of intangible assets (availability of qualified, highly motivated employees and client information databases) into financial results; it also makes it possible to comprehensively and systematically consider the strategy developed by the enterprise, etc.

In accordance with the target performance indicators of the enterprise as a whole, target values are also formed for structural subdivisions. For each of these, a set of necessary measures aimed at achieving the goals is developed.

In other words, there is a cascade of indicators, with each department receiving its own system. Thus, the BSS connects the enterprise's strategic goals and the structural units' tactical actions. The scorecard helps employees to understand the company's strategy and overall mission, and also to connect their own goals with those of the company.

Each of the six components required for a balanced scorecard is usually formulated in greater detail. Indicators and target values can be set using formulas, measurement objects, data sources, reporting periods, target dates and so on. As a rule, quantitative indicators are used to analyse and evaluate the final results of the developed strategy. The factors and reasons that determine the final result can be represented by both quantitative and qualitative indicators. Initiatives regarding the implementation of project measures also require documentation of work schedules, determination of resources, and identification of potential risks and benefits.

The analysis conducted revealed that the primary distinction between the balanced system of indicators and alternative methods of evaluating management effectiveness lies in the simplicity of its application format, specifically the utilisation of a scorecard characterised by a limited range of indicators. It also emphasised the importance of considering the interrelation between directions and indicators, as well as the system's high adaptability. The scorecard delineates the system of indicators, illustrates the dynamics of development and focuses attention on its directions. It has been established by the scientific community that the primary directive in this instance will be the establishment of a set of key activity indicators, not derived from the extant list in the prevailing information and accounting system, but rather their development anew by means of the specification of goals in the form of indicators. A combination of "hard" (market share, order fulfilment time) and "soft" (image, customer satisfaction) indicators, as well as quantitative (easily measurable) and subjective indicators, will be appropriate.

3. Conclusions

Based on the main analysis, we highlighted the main advantages of a balanced system of indicators over other performance measurement systems, which are: the possibility of transferring the mission and strategy of the enterprise into a system of goals reflected by a system of interrelated indicators; the presence of a logical connection between individual goals, which involves studying the cause-and-effect relationship between all indicators included in the system;

Table 3
Scorecard of the balanced scorecard

Elements	Aims	Cause and effect relationships	Indicators	Target values of indicators	Activities
Finances					
Clients					
Internal processes					
Training and development of personnel					

Source: supplemented based on data

interrelationship of performance indicators and factors for increasing their efficiency.

The contemporary paradigm of quality for customers and consumers, the organisation of processes, the status and development of personnel, and so forth. Concurrently, the supplementary indicators demonstrate mutual consistency with the financial outcomes of the enterprise. The system's capacity to facilitate feedback between internal processes and external factors contributes to enhancing efficiency and attaining activity outcomes.

The formation of a balanced system of indicators and the selection of methods for reducing them to certain generalised indicators is carried out by each enterprise separately, depending on the specifics and objectives of its activities. They are subject to annual review in accordance with the planning cycle. Its main elements are goals, and indicators will change every year: goals may need to be refined; indicators may undergo changes in calculation methods, descriptions, reporting frequency, increase or decrease in the number of indicators, etc.

References:

Kopnov, V. A., & Rogov, A. A. (2008). Measuring the efficiency of QMS. *Standards and Quality*, (3), 60–64.

Bart, T. V., & Efimov, V. V. (2006). Quality management. Moscow Institute of Economics, Management and Law Press, p. 394.

Veksler, E. M. (2008). Quality management. VD Professional Press, p. 320.

Androsiuk, L. A. (2014). Modeling the process of managerial decision-making in printing enterprises. *Intellect XXI*, (1), 28–34.

Ilenkova, S. D., Ilenkova, N. D., Mkhitarian, V. S., & et al. (2003). Quality management: A textbook for universities. Banks and Exchanges: UNITY Press, p. 334.

Markina, I. A., & Burdelna, G. O. (2011). Product quality management at industrial enterprises: A monograph. Intex-LTD Publishing House, p. 207.

Lepiyko, T. I., & et al. (2011). Management in publishing and printing structures: A textbook. Kharkiv National Economic University Press, p. 350.

Momot, O. I. (2007). Quality management and quality system elements: A textbook. Center for Educational Literature, p. 368.

Feigenbaum, A. V. (1991). Quality Control (3rd ed.). McGraw-Hill.

Verkhovna Rada of Ukraine. (1997). The Law of Ukraine "On Publishing". Available at: https://zakon.rada.gov.ua/laws/show/318/97-%D0%B2%D1%80#Text

The System for the Development and Delivery of Products to Production (2000). Available at: https://www.dnu.dp.ua/docs/ndc/standarts/DSTU_3974-2000.pdf

Gutkevych, S. O., Punchak, L. A., & Yazvinska, O. M. (2015). Modern quality paradigm: A monograph. NTUU "KPI" Press, p. 252.

Gutkevych, S. O., & Haydutskyi, A. P. (2022). Investments: A textbook. S. O. Gutkevych (Ed.). DKS Tsentr Press, p. 320.

Kaplan, R., & Norton, D. (1992). The balanced scorecard – measures that drive performance. Harvard Business Review, 79.

Maisel, L. S. (1999). Performance management: The balanced scorecard approach. *Journal of Cost Management*, 13(1), 27–45.

McNair, C. J., Lunch, R. L., & Cross, K. F. (2000). Do financial and nonfinancial performance measures have to agree? *Management Accounting*, 82–91.

Adams, C., & Roberts, P. (1993). You are what you measure. *Manufacturing Europe*, 2, 11–19.

Received on: 19th of April, 2025
Accepted on: 02th of June, 2025
Published on: 25th of June, 2025