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USING THE KEY PERFORMANCE INDICATOR (KPI) SYSTEM AS A MANAGEMENT TOOL FOR ENSURING INNOVATIVE DEVELOPMENT OF BUSINESS ENTITIES

Summary

Within the framework of the conducted research, the place of the Key Performance Indicator in the general strategy of innovative development of the subject of entrepreneurial activity was determined. The use of the Key Performance Indicator (KPI) system based on the principles of the process-system approach is substantiated, which made it possible to single out the elements of the concept of ensuring innovative development, which include seven stages: formation of the KEY PERFORMANCE INDICATOR system of innovative development; determination of a set of indicators for each of the selected areas based on correlation analysis of the relationships between individual indicators; determination of its critical (reference) value for each indicator; determination of the weight of individual indicators by the method of expert assessments; formation of generalized indicators for each area, taking into account the defined set of indicators and their weight; calculation of the degree of achievement of the normative (reference) value of each indicator of innovation efficiency. This allows business entities to comprehensively assess the effectiveness of innovation development management, as well as to predict its effectiveness for the previous period.

Introduction

Many subjects of entrepreneurial activity, in order to ensure innovative development, at some point are generally faced with the instability of work

results. The past accounting period may show good profitability, while the current one barely manages to break even. In order to identify the source of the problem and continue the innovative path of development, business entities need only implement key performance indicators or Key Performance Indicators (KPI). They allow you to monitor the performance of each employee, and the entire business in general, and to correctly adapt the key indicators control system in a specific case. It is the Key Performance Indicators of Innovation Development that determine strategic success and serve as a criterion for areas that may need improvement, as well as an important tool for innovative development and achievement of high-quality results by business entities.

Features of the use of the KPI system are highlighted in the works of foreign and Ukrainian scientists and practitioners, in particular, V. Lavrenenko [3], B. Prokhorova, O. Lonevskyi [7], I. Filimoshkina [6], S. Tulchynska and O. Solosich [12] and others. The authors focus their attention on the problems of applying the system of performance indicators, which is used in the coordination of processes and control of the results of the enterprise, as well as in the development of management decisions to eliminate deviations arising in the process of operational activities of the enterprise and achievement of its strategic goals. At the same time, the innovative development of business entities with the use of KPI has not been considered enough in scientific works and requires further research and coverage.

The purpose of this study is to highlight one of the innovative approaches to the problems of effective management of innovative development of business entities based on the use of key performance indicators (KPI), namely KPI-innovative development.

The unity of the theoretical and empirical levels of knowledge reflects the set of methods that was used to solve the tasks and verify the initial assumptions in the research process, namely: theoretical: methods of scientific analysis and generalization of the experience of making managerial decisions, comparative method, modeling method; empirical methods, as well as mathematical and statistical methods.

Part 1. Baseline of key performance indicators or Key Performance Indicator

As you know, the founder of the performance evaluation system through Key Performance Indicator and management by objectives is Peter Drucker. It is used to assess the effectiveness of the subjects of entrepreneurial activity in achieving their goals, which gives an opportunity to assess their condition and help in the assessment of the implementation of the general strategy of innovative development (Figure 1).

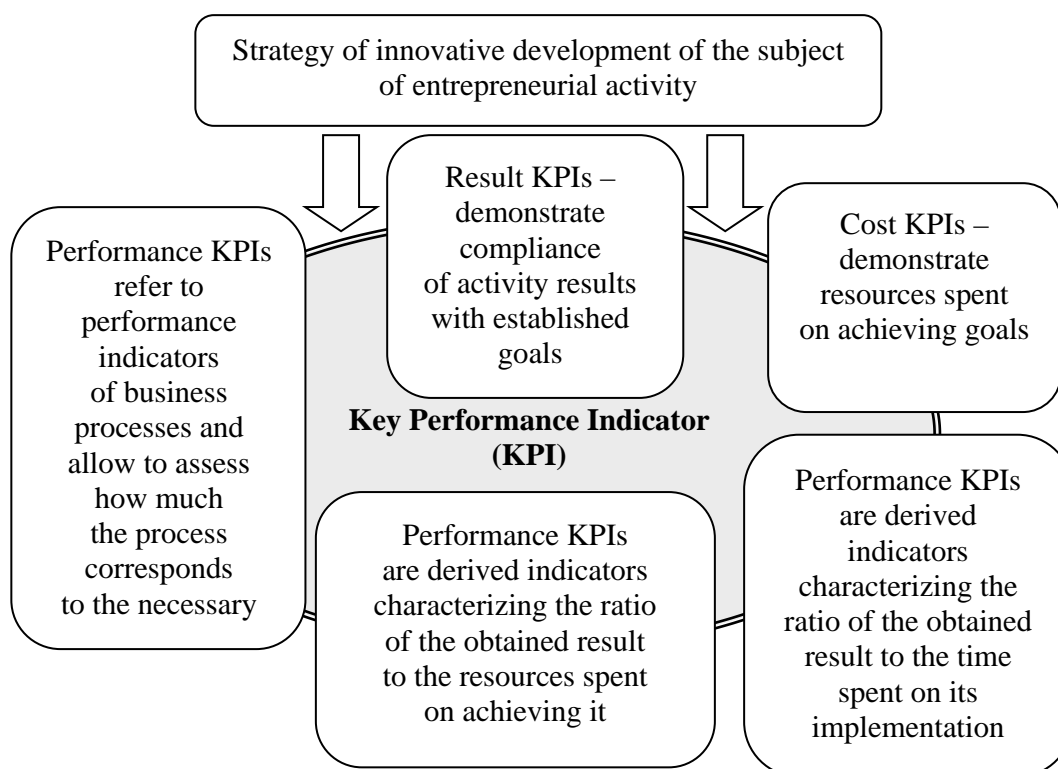


Figure 1. The place of the Key Performance Indicator in the general strategy of innovative development of the subject of entrepreneurial activity

Source: compiled by the authors according to [1; 5; 6; 9]

Key performance indicators or Key Performance Indicators (KPI) are the main component for determining the strategy of innovative development of a business entity. Therefore, the use of the Key Performance Indicator (KPI) system is an effective competitive tool, that is, a real opportunity for business entities to achieve competitive advantages due to effective management of activities, and is the foundation of any general strategy of innovative development.

In our opinion, the use of the Key Performance Indicator (KPI) system should be based on the principles of the process-system approach, using three areas of strategic management (Figure 2).

Based on the definition of M. Porter [2; 3; 4] and taking into account the peculiarities of the activities of business entities, we will define the value chain. The value chain is a coordinated set of activities that create value for business entities, including supporting processes and basic business processes (Figure 3).

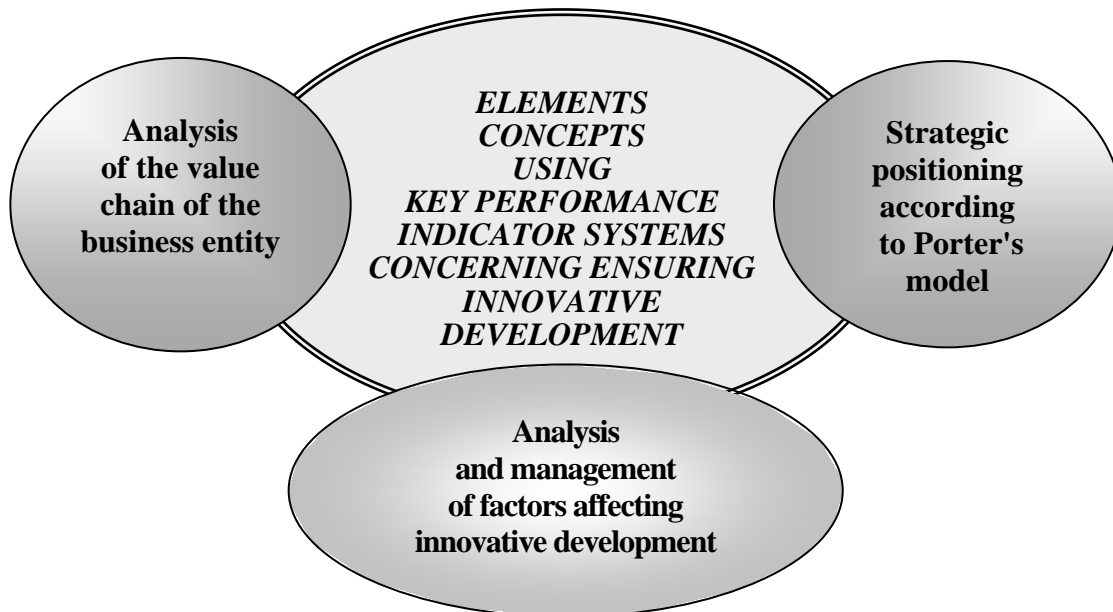


Figure 2. Elements of the concept of using the Key Performance Indicator (KPI) system to ensure innovative development

Source: compiled by the authors according to [1; 5; 6; 9]

Taking into account the value chain creates an opportunity to analyze and justify the necessary actions for the formation of such a product, which will be highly valued by consumers. The result of this analysis should be added value that exceeds the costs of its creation, and this, in turn, ensures a higher profit for the subject of entrepreneurial activity.

The general methodology of using values in the concept of strategic management of innovative development includes the following stages:

1. Construction of the value chain of the subject of entrepreneurial activity and establishment of costs, income and assets for all types of economic activity, which are links of the chain.
2. Establishment of cost-generating factors regulating each type of economic activity.
3. Justification of the direction of achieving competitive advantage: through better than competitors' management of cost factors, or through reconfiguration of the value chain.

The second element of the concept is the study of the company's strategic position.

The strategic positioning of the subject of entrepreneurial activity according to Porter's model [2–5] makes the choice of strategy dependent on five forces: suppliers, buyers, the threat of the appearance of substitute goods, the threat of new competitors entering the industry and the existing intensity of competition within the industry. This, as we can see, confirms the importance of using the Key Performance Indicator (KPI) system in the general system of strategic management of the innovative development of the business entity.

In our opinion, for the assessment of strategic positioning within the framework of the use of the Key Performance Indicator (KPI) system, it is important to understand the strategic direction of the business entity (its basic development strategy) according to M. Porter's matrix of competitive strategies. At the same time, in order to take into account the dynamism and constant changes of the competitive environment (it is assumed that the limits of competition are stable and defined), it is necessary to introduce new business models and create unique competencies that will allow, without competition, to reach a new level.

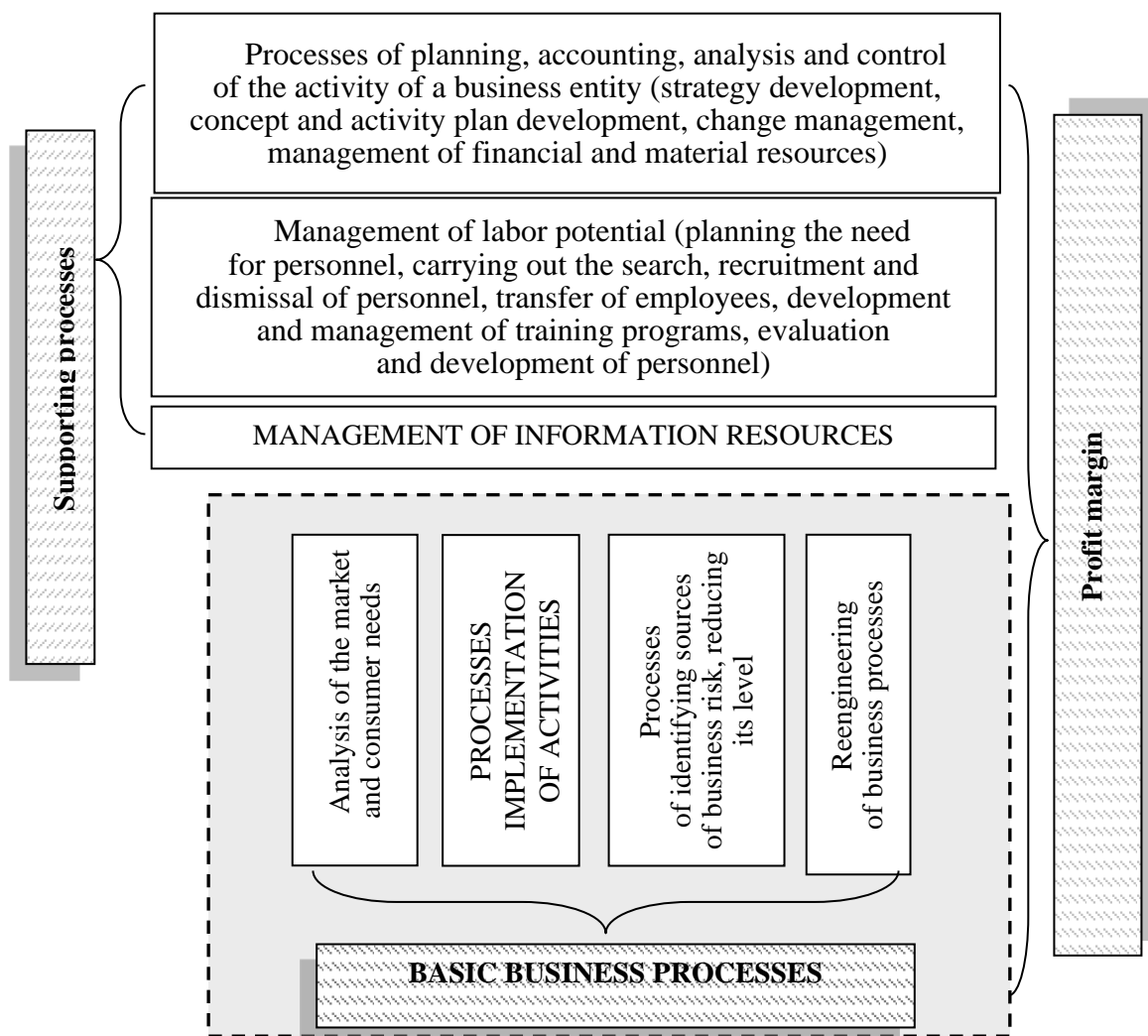


Figure 3. Scheme of a typical "value chain" of business entities

Source: compiled by the authors according to [2–7]

With this in mind, a third lever was included in the concept of strategic management of innovative development using the Key Performance Indicator (KPI) system, which provides for the analysis and management of factors that specifically affect the innovative development of a business entity.

To determine the key influencing factors, we consider it expedient to use the matrix method, that is, information can be presented by various types of matrices, by combining three features: resources, abilities and competencies.

						Resource														
	3*	5	3	4	5	y1	Image and reputation of the enterprise	y1	4	1	0	5	0	0						
	5	5	5	4	3	y2	Managers	y2	2	0	5	5	3	2						
	2	1	0	0	0	y3	Accounting department	y3	5	1	2	0	3	1						
	0	0	5	5	5	y4	Production (trade and operational) personnel	y4	5	5	0	0	3	5						
	0	0	4	3	5	y5	Material and technical base	y5	0	4	0	0	0	3						
ABILITIES	z1	z2	z3	z4	z5							x1	x2	x3	x4	x5	x6	KPI OF INNOVATIVE DEVELOPMENT		
	Market monitoring	Channels of product supply	Inventory management	Personnel management	Flexibility of customer service							Profitability of the enterprise	Level of expenditures on research and development	Level of formation of the management system for innovative development during the life cycle	Identification of the level of business risk	Implementation of the marketing plan	Loading of production capacities			
	z1	z2	z3	z4	z5				x1	x2	x3	x4	x5	x6						
	0	0	3	5	5	c1	Professional competencies of the staff	c1	3	3	4	4	2	2						
	1	4	1	4	5	c2	The intensity of the flow of customers	c2	4	3	4	4	3	3						
	0	5	4	3	5	c3	Satisfaction of consumer demand	c3	2	3	3	4	2	1						
	5	4	5	0	5	c4	Optimality of the range	c4	2	3	3	4	2	2						
	0	0	4	0	5	c5	Equipment level	c5	3	3	3	4	2	2						
	0	0	2	1	5	c6	Logistics of the activity process	c6	4	3	4	4	3	2						
	2	5	4	5	4	c7	Ability to organize the process of activity	c7	3	3	4	4	2	2						
	0	0	1	5	5	c8	Loyalty of the staff	c8	4	3	4	4	3	3						
						COMPETENCIES														

* values are rounded to integers;

expert data are in italics; calculated data are in bold.

-➔ - matrix aik = {XY} – "resources – KPI of innovative development"; 0 – do not affect at all
- ➔ - matrix bkj = {YZ} – "resources-abilities"; 1 – moderate impact
- - - ➔ - matrix = {ZC} – "abilities-competencies"; 2 – below average impact
- - - ➔ - matrix cij = {ZX} – "abilities – KPI of innovative development"; 3 – medium impact
- . . ➔ - matrix dpj = {XC} – "competencies – KPIs of innovative development"; 4 – quite significant impact
- 5 – strong impact

Figure 4. Interrelation of resources, abilities and competences with KPI of innovative development

Source: compiled by the authors

On the basis of the developed model of communication of these features, by $X = \{x_1, x_2, x_3 \dots, x_n\}$ let us denote the key performance indicators, by $Y = \{y_1, y_2, y_3 \dots, y_m\}$ – a set of resources, by $Z = \{z_1, z_2, z_3 \dots, z_k\}$ – a set of abilities, and by $C = \{c_1, c_2, c_3 \dots, c_l\}$ is a set of competencies, then the established groups of relations can be specified by matrices, respectively, $a_{ik} = \{XY\}$, $c_{ij} = \{YZ\}$, $b_{kj} = \{ZC\}$.

Thus, specific relationships will be determined by the matrices presented in Figure 4 (arrows show the influence vectors, in the cells of the matrix, quantitative assessments of the degree of influence are placed on a five-point scale).

In part of the matrix $\{YZ\}$, the degree of involvement of the resource in the execution of the process and, accordingly, the dependence of the level of the quality of the ability on a specific resource are set.

Similarly, in the lower part of the $\{ZC\}$ matrix, the degree of dependence ("controllability") of abilities is placed on each competence revealed by the expert method.

The ratio $\{XY\}$ shows the degree of "use" of each resource in certain types of innovative development, and, accordingly, the degree of dependence of properties on the corresponding resources.

When obtaining the analysis data, the formation of the strategic plan is based on the principle of reverse logic: the carriers of the key and most important competencies are identified, the abilities (business processes) and resources that they manage are identified, and further innovative development of business entities is built to support and develop these and directly related elements.

Part 2. Substantiation of the algorithm for determining the Key Performance Indicator of innovative development of a business entity

The result of the analysis using the Key Performance Indicator (KPI) system, thus, is not only a conclusion about the effectiveness of the current configuration of the business system in terms of the formation of an effective management system for innovation development, but also an unambiguous determination of the point of the most effective application of efforts and resources, structuring and ranking of the rest of the field.

Based on the fact that the strategic management of innovation development of a business entity is based on a system of performance evaluation through Key Performance Indicator, and strategic management itself is aimed at determining the opportunities and prospects for the development of a business entity in the future, the strategy of innovation development management should be determined on the basis of the relationship of competencies with their overall effectiveness of innovation development management.

However, the analysis of the literature and the practice of using the Key Performance Indicator (KPI) system [1; 5; 6; 8; 9] suggests that at the present stage there is no sufficiently effective method for assessing the effectiveness of innovation development management. Therefore, we consider it expedient to use the KPI of innovation development, which will allow business entities to comprehensively assess the effectiveness of innovation development management of a business entity, as well as to predict their effectiveness for the previous period.

The algorithm for determining the KPI of innovative development of a business entity is shown in Figure 5.

1st stage. The formation of the KPI system of innovative development is carried out on the basis of theoretical studies of indicators of the effectiveness of innovative development, which are widely covered in scientific and theoretical works of domestic and foreign researchers in the field of management of innovative development of business entities.

Stage 2. Analysis of indicators characterizing all aspects of performance. For the objectivity of the analysis, a statistical method of evaluation is used, which is based on the use of mathematical tools of statistical research, that is, the definition of a set of indicators for each of the selected areas based on a correlation analysis of the relationships between individual coefficients.

To determine the correlation relationship, we propose to use the following formula for calculating the correlation coefficient [10; 11].

$$\rho_{xy} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n} \right] \times \left[\sum Y^2 - \frac{(\sum Y)^2}{n} \right]}}, \quad (1)$$

where X, Y – a series of signs;

n – number of data pairs.

The input data for the study are indicators of the effectiveness of innovative development.

Stage 3. Determination of the critical (reference) value for each indicator of innovation development.

Stage 4. Determination of the weight of individual indicators by the method of expert assessments. Establishing the level of importance of innovation development indicators characterizes the importance of a particular indicator for an objective assessment of the effectiveness of innovation development management. The weight of indicators may vary significantly depending on the specifics of the activities and operating conditions of a particular business entity, as well as for the same business entity in different periods of the life

cycle may vary. The level of importance of the indicators is determined by expert assessments of specialists based on a questionnaire.

Stage 5. Formation of summary indicators for each direction, taking into account the defined set of indicators and their weight.

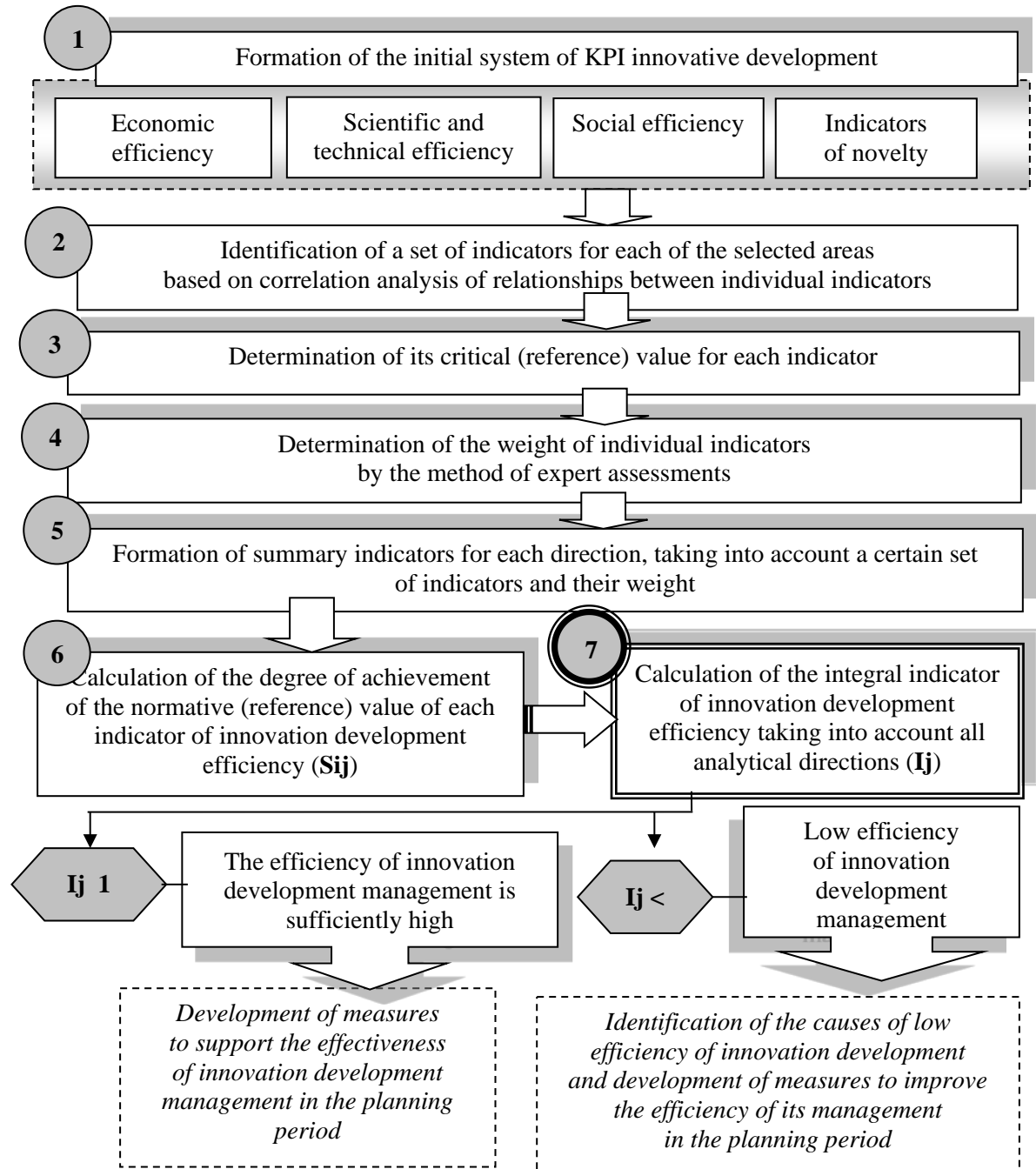


Figure 5. Algorithm for determining the KPI of innovative development of a business entity

Source: compiled by the authors

Taking into account the individual indicators selected at the second stage and their weight, the integral indicator includes two elements: the normative (reference) value of the indicator and its significance. When comparing the actual and reference values, the degree of achievement of its norm by the indicator is determined.

All generalizing indicators are basically calculated mainly by two methods: either on the basis of the arithmetic mean weighted value (1) or the geometric mean of the degree of achievement of the norm by a separate indicator of its reference (normative) value (2):

$$I_j = \frac{\sum_{i=1}^n S_{ij} \times \beta_{ij}}{\sum_{i=1}^n \beta_{ij}}, \quad I_j = \sum_{i=1}^n \beta_{ij} \sqrt[n]{\sum_{i=1}^n (S_{ij})^{\beta_{ij}}}, \quad (2)$$

where I_j – an integral indicator that characterizes the strategic efficiency of managing the innovative development of a business entity;

S_{ij} – the degree of achievement by a particular indicator of its reference (normative) value (taking into account the possibilities of improving the efficiency of innovative development), which is calculated for a particular business entity;

β_{ij} – the significance of a particular indicator for a particular business entity.

Stage 6. Calculation of the degree of achievement by a particular indicator of its normative value can be carried out using subjective and objective methods. Subjective methods include all kinds of expert assessments, ranking of indicators, assessment of significance in percentage or some scale of measurement. The degree of achievement by a particular indicator of its normative value can be carried out by using various objective methods based on calculation [12]:

- Euclidean distance between the indicators of innovation development efficiency;
- the geometric mean;
- the sum method;
- the sum of place method, etc.

However, these methods do not take into account the possibility of increasing the efficiency of circulation costs in the formation of their comprehensive assessment, which can lead to inefficiency in the management of circulation costs in the planning period. Therefore, it is advisable to determine the degree to which a particular coefficient achieves its normative value, which is possible on the basis of calculating the distance matrix [11; 12].

Assessment of opportunities to improve the efficiency of innovation development can be carried out using taxonomic methods of comparative

multivariate analysis. Indicators for different business entities can be presented in the form of a matrix of observations:

$$\begin{bmatrix} K_{11} \cdots K_{1j} \cdots K_{1n} \\ \dots\dots\dots\dots\dots\dots \\ K_{i1} \cdots K_{ij} \cdots K_{in} \\ \dots\dots\dots\dots\dots\dots \\ K_{m1} \cdots K_{mj} \cdots K_{mn} \end{bmatrix} \quad (3)$$

where K_{ij} – is the value of the j -th indicator of the i -th business entity;
 m – number of areas of activity of the business entity;
 n – the number of indicators by which the possibilities of improving the efficiency of innovative development are assessed

Due to the fact that indicators for assessing the effectiveness of innovation activities have different vectors of influence on the overall innovation development of the business entity, that is, they can be stimulants or destimulants. In this case, if the change in the indicator has a positive impact on the final results of the activity (leads to an increase in the score), the indicators are classified as stimulants, and indicators with the opposite effect – as destimulants, the elements of the matrix are standardized according to the formulas:

$$KC_{ij} = \frac{K_{ij} - K'_j}{\sigma_j}, \quad (4)$$

where KC_{ij} – the standardized value of the j -th indicator for the i -th business entity;

K'_j – is the maximum or minimum (depending on the vector of influence on the efficiency of innovation development) value of the j -th indicator;

σ_j – is the standard deviation of the j -th indicator.

$$\sigma_j = \left[\frac{1}{m} \sum_i (K_{ij} - K'_j)^2 \right]^{0.5}, \quad (5)$$

The distance of the value of a certain coefficient of a particular business entity from the reference value (BE_{i_0}) is calculated according to the formula:

$$BE_{i_0} = \left[\sum_j (KC_{ij} - KC_{0j})^2 \right]^{0.5}, \quad (6)$$

where KC_{0j} – coordinates of the point that corresponds to the reference value of the resultant assessment.

Assessment (S_{ij}) of opportunities to improve the efficiency of innovation activities of the business entity is carried out on the basis of the following calculations:

$$S_{ij} = 1 - \frac{BE_{i0}}{E_0}, \quad (7)$$

where E_0 – is the maximum possible distance of the indicator value from its reference value;

$$E_0 = \overline{E_0} + 2\sigma_0, \quad (8)$$

where $\overline{E_0}$ – the average value of the distance from the standard;

σ_0 – the standard deviation of the distance from the reference value of the indicator.

$$E_0 = \frac{1}{m} \sum_i BE_{i0} + 2 \left[\frac{1}{m} \sum_i (BE_{i0} - \frac{1}{m} \sum_i BE_{i0})^2 \right]^{0.5}. \quad (9)$$

Stage 7. Calculation of the integral indicator of innovation management efficiency taking into account all generalizing indicators. Given that the calculation of the integral performance indicator is based on the values of the selected indicators, the integral indicator characterizing the strategic efficiency of innovation development management will be calculated as follows:

$$I_j = \frac{S_1 k_{1j} \times \beta k_{1j} + S_2 k_{2j} \times \beta k_{2j} + S_3 k_{3j} \times \beta k_{3j}}{\beta k_{1j} + \beta k_{2j} + \beta k_{3j}}, \quad (10)$$

or,

$$I_j = \sqrt{\beta k_{1j} + \beta k_{2j} + \beta k_{3j}} \sqrt{S_1 k_{1j} \times \beta k_{1j} + S_2 k_{2j} \times \beta k_{2j} + S_3 k_{3j} \times \beta k_{3j}}, \quad (11)$$

where Sk_{1j} – the degree of achievement of the indicator 1 to its maximum (reference) value in the direction of activity at a separate business entity;

Sk_{2j} – the degree of achievement of the indicator 2 to its maximum (reference) value in the area of activity at a separate business entity;

Sk_{3j} – is the degree of achievement of the n-indicator to its maximum (reference) value in the direction of activity at a separate business entity;

βk_{1j} – significance of the indicator 1 in the area of activity at a separate business entity;

βk_{2j} – significance of the indicator 2 in the direction of activity at a separate business entity;

βk_{3_j} – significance of n-indicator in the direction of activity at a separate business entity;

$$I_j = \frac{(1 - \frac{BE_{i0}^{K_1}}{E_0^{K_1}}) \times \beta k_{1_j} + (1 - \frac{BE_{i0}^{K_2}}{E_0^{K_2}}) \times \beta k_{2_j} + (1 - \frac{BE_{i0}^{K_3}}{E_0^{K_3}}) \times \beta k_{3_j}}{\beta k_{1_j} + \beta k_{2_j} + \beta k_{3_j}}; \quad (12)$$

$$I_j = \sqrt{\beta k_{1_j} + \beta k_{2_j} + \beta k_{3_j}} \sqrt{(1 - \frac{BE_{i0}^{K_1}}{E_0^{K_1}})^{\beta k_{1_j}} + (1 - \frac{BE_{i0}^{K_2}}{E_0^{K_2}})^{\beta k_{2_j}} + (1 - \frac{BE_{i0}^{K_3}}{E_0^{K_3}})^{\beta k_{3_j}}}. \quad (13)$$

To assess the value of the integral indicator, the following assessment scale is used (Table 1).

Table 1

Scale of evaluation of values of the integral indicator of efficiency of innovation development management

The value of the integral indicator	Characteristics of the effectiveness of innovation development management and main recommendations for its improvement
$I_{ij} \geq 1$	the efficiency of management of innovative development of the business entity is at a high level and it is necessary to develop measures to maintain the existing state
$I_{ij} = 1$	the efficiency of management of innovative development of the business entity is at an average level, it is necessary to develop measures to stabilize management
$I_{ij} \leq 1$	the efficiency of management of innovation development of the business entity is low and the business entity is in an unsatisfactory condition and it is necessary to direct efforts to develop measures to improve its efficiency. In this case, it is necessary to analyze each of the elements of the integral indicator, as well as the individual components that form these elements.

Source: compiled by the authors

Thus, the assessment of the effectiveness of the management of innovative development of the business entity on the basis of KPI-innovative development has certain advantages, because it is based on the principle of differential analysis, which simplifies the process of identifying weaknesses in the management of innovative development of the business entity, which negatively affect the overall performance of its activities and allows to determine the directions of strategic development to improve the existing state and justify the strategy of further development of the entities.

Conclusions

Summarizing the above, we conclude that in order to achieve the purpose of the scientific research, the elements of the concept of using the Key

Performance Indicator system to ensure the innovative development of the business entity are substantiated. The matrix method was used by combining three features: resources, abilities and competencies, which contributes to the understanding of the strategic orientation of the business entity (its basic development strategy).

Based on the justified starting points, an algorithm for determining the Key Performance Indicator of innovative development of a business entity has been developed, with the help of which the level of efficiency of managing the innovative development of a business entity is determined. Assessment of opportunities to improve the efficiency of innovative development can be carried out using taxonomic methods of comparative multivariate analysis. In the course of the study, it was noted that the indicators for assessing the effectiveness of innovation activity have different vectors of influence on the overall innovative development of the business entity: if a change in the indicator has a positive impact on the final results of the activity (leads to an increase in the score), the indicators are classified as stimulants, and indicators that have the opposite effect are classified as discouragers. Therefore, the elements of the matrix were standardized and it was proposed to calculate the integral indicator of efficiency of innovation development management, taking into account all generalizing indicators. This will help to identify the negative factors affecting the innovative development of business entities and allows to determine the directions of strategic development to improve the existing situation and justify the strategy for further development of the business entity.

Thus, the correct implementation of the Key Performance Indicator of innovative development of the business entity will increase the efficiency of its activities, improve motivation among employees and become a catalyst for innovative business development.

The scientific novelty of the results obtained is the development of methodological foundations of innovative development of business entities based on the formation of a system of indicators for assessing the effectiveness of innovative development management both by individual performance criteria and in relation to the entire management process.

The scientific results and developments of the authors have not only theoretical but also applied significance for solving specific practical problems of business entities to build a balanced system for assessing the management of innovation development processes.

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