

27. CRITERION OF REFERENCE DYNAMICS OF DEVELOPMENT OF INNOVATIVE PROJECT-ORIENTED ENTERPRISES

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In the era of the knowledge economy, the main type of enterprises that are most appropriate to the features of its functioning are innovative project-oriented enterprises. The work of such enterprises is associated with a high degree of uncertainty, which is synergistically enhanced by the main source of their development - the implementation of innovative projects. This makes it difficult to apply traditional parameters and evaluation criteria for their activities to effectively manage their functioning and development. Promising in this regard is the application of criteria developed on the basis of the holistic application of the concepts of temporal indicators, value approach and intellectual capital. The article describes the approach to the construction of the criterion of reference dynamics, which takes into account the accumulated experience of applying the criterion previously developed by us in real enterprises and the practice of its application by other researchers. The developed eight-component reference criterion for assessing the development process fully meets the proposed management principles. For its application, the values of the coefficients of inversion significance for the actual time series, as well as the weight coefficients for the components of the coefficient of decrease in the integral development indicator, are calculated. The latter takes into account the deviation of the actual values of the rates of growth of indicators from 100% in the direction of decrease. Taking into account the proposed two coefficients showed that for real IPOE the values of the integral development indicator can differ by four or more times in the direction of decrease compared with the calculations without taking them into account.

Introduction

Modern economy has a lot of associative characteristics. It is called global, creative, innovative, open, informational, design, knowledge economy, etc. And each of these characteristics is objective, because we feel their constant manifestation in everyday life. There is a change in the stages of development of civilization, which leads to a change in the organization of activities of all types and forms of business entities (from small to large enterprises, firms and corporations). But regardless of the size and type of activity, a common trend for all business entities is the transition to managing their business activity through projects [1]. The basis of most projects today is innovation and new technology. Business

entities that switched to management through innovative projects were called innovative project-oriented enterprises (IPOE) [2]. Practice shows that innovative projects play a priority role in corporate changes, growth and development of such companies. Moreover, innovative projects for top management present a major problem due to the high degree of their uncertainty [3]. To solve these problems, new IPOE management methods are being developed, for example, based on the concept of harmonization of design and innovation activities [4]. However, the constant external changes in the environment of enterprises, the emergence and manifestation of a variety of local and global economic and financial crises do not remove the task of effective management of IPOE in such conditions. Therefore, there is a need for criteria for assessing the correctness of the management of IPOE as a holistic entity. Today, the search for such criteria lies in the intersection of the concepts of temporal indicators, value approach and intellectual capital. The practice of working with the previously proposed indicators of reference dynamics for IPOE, which contained four components [5], showed the feasibility of increasing their number by introducing components that detail the design and innovation activities. In this case, it is advisable to develop general principles of IPOE management based on indicators of reference dynamics. In the development process, it is necessary to focus on the emerging new family of temporal indicators, which is used to assess the impact of innovation and entrepreneurship on the economy of socio-economic systems of various sizes [6].

Conceptual provisions

The concept of proper enterprise management is a subjective category. This is due to the fact that enterprises independently develop systems of key indicators, which, in their opinion, characterize them as successfully developing. Correspondence of the actual course of the functioning and development of the enterprise to the management principles adopted by them can serve as a criterion for the correctness of management. The principles should be considered as a measure, from the position of which the management decisions made are evaluated, the products obtained as a result of their implementation, and the consequences of using these products (result).

For IPOE, the basic principles of management should be presented in the form of the following statements.

1. The principle of comparability and subordination of indicators of stakeholders. All indicators that take into account the diverse interests of IPOE stakeholders should be dynamically comparable and dynamically related.

2. The principle of maximizing the growth of the market value of the enterprise. Management decisions should be aimed at maximizing the growth of the market value of the

company in the long term, which is determined by the duration of the change of innovation in the subject area of the enterprise.

3. The principle of priority of the growth rate of the intangible component of market value. The prevailing indicator in a dynamically subordinate criterion series is the growth rate of the intangible component of the market value of the enterprise.

4. The principle of consistency of growth rates. The model of the integral criterion of management effectiveness should be built on the basis of the consistency of growth rates indicators that describe the design and innovation activities of IPOE.

5. The principle of Miller. The number of growth rate indicators in the integral criterion model should correspond to the Miller principle $(7 + -2)$.

These principles are a modification of the well-known provisions that are used in management. The modification was aimed at strengthening the practical aspect of the principle, which allows them to be applied at all levels of IPOE management without additional refinement.

The described principles make it possible to determine the structure of the criterion for the integrated assessment of IPPO activities. As the basis of the criterion, we use a four-component time series, which has the following form:

$$TV_{t_i} > TR_{t_i} > TS_{t_i} > TL_{t_i} > 100\%, \quad \text{for } t=t_1, t_2, \dots, t_j, \quad (1)$$

where t_j – time points for which indicators are measured;

$T(\cdot)$ - indicates that the growth rate is used (\cdot).

Consider in more detail the performance of the time series. Indicator V is the specific weight of the added market value of the enterprise in its market value from the use of the most important intellectual property objects, which provide it with market competitive advantages and, first of all, in the long-term strategic perspective. The calculation of the added market value of VIC - Value of Intangible Component was proposed by N. Lyashenko in [7]. For IPOE, the rate of change should be greatest compared to the growth rate of other indicators. This indicator meets the requirements of the third management principle.

The second indicator of the time series is the growth rate of profitability R . Today, profitability is the most commonly used indicator of economic efficiency, because holistically reflects the degree of efficient use of all resources of the enterprise and the success of its work. It is essentially relative, and, in contrast to the profit indicator, takes into account the value of those assets, the use of which made it possible to make a profit. Indicators V and R are specific. This meets the requirement of comparability of indicators arising from the first principle.

Today, almost all IPOEs, regardless of their size, conduct research and development ($R\&D$), their competitiveness largely depends on the amount of costs for these types of work.

Therefore, it is advisable to use the growth rate of the specific share of costs S on $R\&D$ in the total cost as the third indicator of the time series. This indicator is also specific.

As the fourth indicator, the growth rate of the specific share of labor costs L in the total cost was used.

The four-component time series (1) is essentially the same as the “golden rule of enterprise economics”. But it does not have enough indicators that reflect the state of the main source of competitive advantages of IPOE - human capital. It can be considered as a source of energy for the implementation of interdependent activities of the individual - physical, creative, creative and intellectual (Fig. 1).

In [8] M. Sc. Dimov proposed to define an innovative enterprise as an enterprise that has a certain type of competencies or their correlation, as well as the correlation between categories of personnel with specific and functional competencies. Using different classifications, he divided the staff into: researchers and other research personnel; analytical, technical and other applied specialists; managers, administrative staff, researchers, technical staff and support staff. At the same time, the author emphasized that it is possible to determine specific competencies for production and executive personnel. But for researchers and innovation leaders, this is much more difficult.

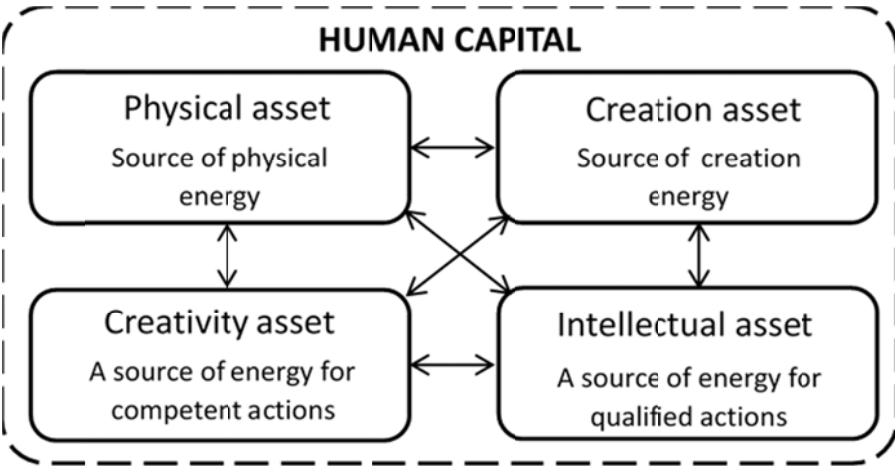


Fig. 1. The structure of human capital by energy sources

Source: developed by the author.

We previously defined IPOE as a company with a hybrid organizational structure, using flexible portfolio management, introducing innovations as separate businesses in order to create new values for consumers. The semantic combination of the model (Fig. 1) with the considered definitions of an innovative enterprise and IPOE, taking into account various classifications of personnel, allows us to propose considering personnel from the standpoint of innovation, design

activity and the release of innovative products. With this consideration, the same employee could theoretically fall into all three categories. This does not contradict the system-holistic vision of activity. The category of “innovation” (*C*) will include employees who generate ideas for innovation (show creative activity), develop and launch them in production (show creative activity). To the category of project activity (*P*) - employees who are intellectually active, and for the release of innovative products (*B*) - physical activity.

For sustainable safe development of IPOE, it is necessary, in accordance with the fourth management principle, to agree on the growth rate of the proposed categories of employees. The higher growth rates of innovators *C* are logical as compared to the growth rates of those employed in projects *P*, which, in turn, should be higher than the growth rates of those engaged in innovative products *B*

$$TC_{t_i} > TP_{t_i} > TB_{t_i} > 100\%. \quad (2)$$

In the structure of time series (1), this time line should be located in front of the growth rate of the specific share of labor costs *L*. Otherwise, the incentive factor for increasing wages to employees who exhibit great, creative, creative and intellectual activity will be lost.

One of the main conditions for the successful operation of IPOE is also its ability to constantly innovate faster than existing and potential competitors. Therefore, the company must track the pace of innovation (*M*) through an individual, flexible approach to the organization of project activities, which should take into account the features of the innovation being introduced. Moreover, these rates should be higher than the growth rate of the specific share of costs *S* on *R&D*.

Given the foregoing, we have proposed a time series that reflects the reference dynamics of the development of IPOE:

$$TV_{t_i} > TR_{t_i} > TM_{t_i} > TS_{t_i} > TC_{t_i} > TP_{t_i} > TB_{t_i} > TL_{t_i} > 100\%. \quad (3)$$

From the point of view of sustainable, safe development, this is the most preferable direction for changing the rates of growth of indicators, which should be sought to maintain throughout the entire period of IPOE operation. The coincidence of the actual time series with the reference one ensures that the enterprise is developing in the chosen direction, that all emerging threats and dangers are overcome without negative consequences. At its core (3) reflects the “strategic rational rule” of the IPOE and is a criterial dynamic model. The criterion displays the priority, most rational arrangement in descending order of its indicators - growth rates. Therefore, in a series of ranks, the first indicator will have the first rank, the second - the second, etc.

The mathematical model for calculating the criterion

We introduce the concept of the actual dynamic range of indicators. It is a series of indicators that are present in the reference series, and their sequence reflects the actual status of activities IPOE. Then to determine the degree of deviation of actual number from the reference you must have an integral indicator, which will characterize the degree of compliance of the actual state development plan (overall development). Will use to build the matrix method. Consider the method for simplicity, the example of dynamic lines consisting of the first four components of the rule (3). Three matrices are built. The first matrix, which reflects the strategic rational (3), i.e. the reference time series (Fig. 2a). The second matrix is the actual dynamic range (Fig. 2b), and the third matrix inversions, which are fixed to different values of the actual matrix compared to the reference (Fig. 2c).

Reference rank order	V	R	S	M
	1	2	3	4
V	1		1	1
R	2	-1		1
S	3	-1	-1	
M	4	-1	-1	-1

a)

Actual rank order	V	R	S	M
	3	1	2	4
V	3		-1	-1
R	1	1		1
S	2	1	-1	
M	4	-1	-1	-1

b)

Indicators, j	i				Inversion
	1	2	3	4	
	V	R	S	M	
V		1	1	0	2
R	1		0	0	1
S	1	0		0	1
M	0	0	0		
Inversion amount					4

c)

Fig. 2. Matrices for calculating the integral development indicator

a) - reference time series; b) - actual time series; c) - inversions.

Source: developed by the author.

The mismatch (proximity) of the first two matrices is usually characterized by the Kendall rank correlation coefficient. However, this coefficient does not take into account the removal of the indicator of the actual dynamic series from its location in the reference series. We have developed a method of accounting for this fact and obtained a working formula in the following form [5]:

$$IDI = \left(1 - \frac{2 \sum_{i=1}^n \sum_{j=1}^n \left(\frac{\alpha_{ij}}{2} \right) m_{ij}}{n(n-1)} \right)^2, \quad (4)$$

where: n – number of indicators in the time series;

m_{ij} – the number of inversions for the indicator, which occupies the i -th place in the j -th row of the actual time series;

α_{ij} – inversion significance factor.

The values of the significance coefficient were experimentally selected for $n = 4$ from the conditions of the multiplicity of their values to 0.05; equality of the sum of all coefficients 12; finding the magnitude of the coefficients in the range of 0.5-1.5; the value of the coefficients for the cells that are on the periphery from the diagonal should be greater than one, and the difference between them should be greater than the difference between the coefficients that are in the cells adjacent to the diagonal.

In [9], the values of the inversion significance coefficients that we obtained were taken as basic and based on them; a method was developed for calculating such coefficients for any number of indicators of the time series. For the time series (3) of eight indicators, their values are given in table 1.

Table 1 - Inversion significance factors for a time series of eight indicators

№	<i>i</i>								
	1	2	3	4	5	6	7	8	
<i>j</i>	1	0	0,75*	0,95	1,15	1,35	1,4	1,45	1,5
	2	0,75	0	0,72	0,92	1,12	1,17	1,217	1,4
	3	0,95	0,72	0	0,68	0,88	0,93	1,117	1,3
	4	1,15	0,92	0,68	0	0,65	0,83	1,017	1,2
	5	1,35	1,12	0,88	0,65	0	0,62	0,8	0,98
	6	1,4	1,17	0,93	0,83	0,62	0	0,583	0,77
	7	1,45	1,22	1,12	1,02	0,8	0,58	0	0,55
	8	1,5	1,4	1,3	1,2	0,98	0,77	0,55	0

*- the basic values of the coefficients are highlighted in bold

Source: developed by the author.

An analysis of the performance of real IPOEs (of which there are very few in Ukraine today compared with countries with a high human development index) showed that there are quite long periods in their activity, when part of the growth rate is less than 100%. Even if the reference rule is implemented in terms of the sequence of parameters, such a situation should be recognized as critically dangerous from the perspective of strategic development. To take this fact into account, we proposed to introduce an additional coefficient of decrease in the integral development indicator calculated by formula (4) in the following form

$$\beta = 1 - (0,21\check{V} + 0,186\check{R} + 0,161\check{M} + 0,137\check{S} + 0,113\check{C} + 0,089\check{P} + 0,064\check{B} + 0,04\check{L}), \quad (5)$$

where: (\check{R}) – deviation of the actual values of the growth rates of the indicators of the reference dynamic series from 100% towards the decrease.

Then the formula (4) for calculating the decrease in the integral development indicator will take the following form

$$IDI = \beta \left(1 - \frac{2 \sum_{i=1}^n \sum_{j=1}^n \left(\frac{\alpha_{ij}}{2} \right) m_{ij}}{n(n-1)} \right)^2. \quad (6)$$

The results of calculating the integral indicator using the Kendall formula, and taking into account the two coefficients we have introduced have shown that for real IPOE their values can differ by a factor of four or more.

Conclusions

Based on our study, we can make the following conclusions.

1. The general trend for all business entities is the transition to the management of business activity through the implementation of projects. Moreover, most projects are aimed at implementing innovations and new technologies. Therefore, such enterprises are called innovative project-oriented (IPOE). The high degree of uncertainty of innovative projects makes it difficult to find criteria for assessing the correctness of development management of such enterprises.

2. It is proposed to use five management principles as a conceptual basis for the development of criteria. Substantially they relate to the intersection of the concepts of temporal indicators, value approach and intellectual capital. As a basis for the criterion, a four-component dynamic series of temporal indicators previously developed by the author is used. It is supplemented by indicators that are associated with the main source of competitive advantages of IPOE - human capital. Human capital is considered as a source of energy for physical, creative, creative and intellectual activity. Each type of activity is inherent in a certain category of employees who are engaged in innovation, design activities or the release of innovative products.

3. For the extended reference dynamic series of temporal indicators of IPOE, a formula has been developed for calculating the integral indicator of its development. It is based on the formula for calculating the Kendall rank correlation coefficient, which is supplemented by two coefficients: the significance of inversions and a decrease in development when the actual growth rate deviates from 100% downward.

4. Accounting for the entered coefficients and the presence of all the constants that are used in their calculation allows us to calculate the value of the integral development indicator, which more adequately reflects the actual state of affairs at IPOE.

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