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O. Senichkina
Lecturer, Department of Management and Business
Kharkiv National Economic University. S. Kuznets

DETECTION OF EFFECTIVENESS FACTORS IMPACT ON INNOVATIVE ACTIVITY OF INDUSTRIAL ENTERPRISES

Statement of the problem. Scientific achievements and intensive development of new technologies resulted in significant changes in the global market, which led the economy of developed countries to shift from scientific and technical to innovation policy. The level of innovativeness of a state depends on the development of enterprises in this field. Industrial enterprises, able to stimulate technological progress, are other industries' multiplier that determines the priority need for technical re-equipment of industry and rise of knowledge-intensive industries. Therefore, it's advisable to analyze the effectiveness of innovative activity of industrial enterprises.

Analysis of recent research and publications. The assessment of the current state of innovation activity in Ukraine and its enterprises is considered by many domestic scientists: Antonjuk L. [1], Khariv P., Sobko O. [2], Petrova I., Shpilova T., Susolina N. [3]. However, these categories are not static. They are constantly changing so require regular analysis to identify major trends.

Statement of the task. The aim of the article is to determine the effectiveness of the innovation activity of certain industrial enterprises of Kharkiv region and to identify factors influencing innovation potential of there personnel.

The main material of research. The results of the analysis of the innovation activity of certain industrial enterprises of Kharkiv region indicate their implementation of innovation activitiy during the period. To assess the innovation results and overall analysis of innovative activity, different methodological approaches of domestic and foreign scientists were used [4-8]. Calculations carried out only within the financial and innovative accounting that enables to evaluate the volume and direction of expenditures, the quantity of creative achievements, and the quantity of creative employees. All these make it impossible to objectively assess the overall innovation activity state, to identify bottlenecks and the relevant effective measures to overcome the possible negative consequences.

In this view, it became expedient to conduct an expert assessment of the required indicators provide an opportunity to accurately and objectively assess the level of innovation activity, innovation spending efficiency and innovative potential of employees of surveyed enterprises. On this basis, three groups of indicators to assess the state of innovation activity formed and their growth rates found at the industrial enterprises at Kharkiv region during 2008-2012. However, to provide more accurate, comprehensive and thorough analysis of these indicators, and to identify their relationship and mutual influence, scientists recommend to conduct research by the pattern which provides: 1) information collection, which envisages supervision and registration of the state of innovation activity and processes of its changes using necessary calculations and measurements; 2) analysis and evaluation, involving matching, comparison, classification, arrangement and systematization of researched properties and factors of innovation activity; 3) selection and justification of indicators and criteria system; 4) construction of evidences of scientific conclusions; 5) interpretation and experimental verification of the conclusions and recommendations [9; 10].

In the economic analysis, the construction of integral or general indicators assumed. To determine objective levels of innovation activity of enterprises it's required to aggregate specific indicators that represent each component of assessment into one integral indicator. Here, the most common methods are scoring or ranking evaluation of individual factors that characterize the performance of an enterprise, assessment of production efficiency, which is based on adding efficiency of its resources - in additive or multiplicative form using multiple models, mixed models and benchmarks methods by significant economic parameters. However, there are two main approaches to assess the functioning and development of object: through the use of the system of basic economic indicators and one economic indicator. The second approach emphasizes the efficiency of the object functioning based on comparing the cost and effectiveness or cost and profit, and the general economic indicator is relative. However, it is considered that complex phenomena and processes are inappropriate to be characterized by one economic indicator. This figure can be absolute or relative and provided by statistical reporting or be calculated as the ratio of the resulting indicator and the index, which indicates the overall cost, which provided results [9].

Thus, analytically the problem of the existence of general indicators in the economy is reduced to the problem of there building, or rather to the approach used − economic (as the ratio of results to costs) or mathematics (with a special mathematical method). Integral indicators are constructed by using a mathematical method, takes values between 0 and 1. System of certain indicators allows to explore the basic features of the object, and restore unity by using mathematical method synthesizes the general characteristics of the socio-economic system.

In general, all known mathematical methods for constructing general indicators of the economy should be considered as two groups. The first group includes methods that require the existence of standard of achieving values and calculation of the distances from the real to the standard level. There are many ways to input metrics, specifying "closeness to the ideal." This group also includes a method for constructing a taxonomic index of V. Plyuta [10], the algorithm of its calculation is given below.

First of all it is necessary to diagnose the system of features on the existence of stimulants that accelerate the development of the phenomena.

Once the features are set, follow calculations undertaken:

1) determination of stimulants, destimulants and nominators among the indicators of socio-economic features of the system:

$X = (x_{ij}), i = \overline{1,m},\ j = \overline{1,n}$, where *i*-th feature for *j*-th period or object.

2) formation of standard: a) by the MiniMax criteria; b) the standard values are established;

3) normalization or standardization of indicators:

$$Z = (z_{ij});\ z_{ij} = \frac{x_{ij} - \overline{x_i}}{\sigma_i},\ \overline{x_i} = \frac{1}{n}\sum_{j=1}^{n} x_{ij}, \sigma_i = \sqrt{\frac{\sum_{j=1}^{n}(x_{ij} - \overline{x_i})^2}{n}}.$$

4) calculation of general indicator values:

$$d_j = \left(\sum_{i=1}^{m}(z_{ij} - z_{i0})^2\right)^{\frac{1}{2}};\ \overline{d} = \frac{1}{n}\sum_{j=1}^{n} d_j;\ \delta = \overline{d} \text{ або } \delta = M_e;$$

$$s_d = \left(\frac{1}{n}\sum_{j=1}^{n}(d_j - \delta)^2\right)^{\frac{1}{2}};\ d = \delta + as_d;\ a = 3;\ d = \delta + 3s_d;$$

$$I_j = \frac{d_j}{d};\ I_j^* = 1 - I_j.$$

Where z_{ij} – standardized values of indicators; $\overline{x_i}$ – average values of indicators; σ_i – mean square deviation of indicators; d_j – distances from standardized values of indicators to the standard; $\overline{d_j}$ – average values of distances; s_d – mean square of distances.

Problems of computing values when calculating taxonomic indicator consist of computing a та δ. a = 3 − number of mean square deviations in the shares σ, which may be 2, if the distribution of features is symmetric, or 3 − in the general case.

Differences in methods of forming the standard should be mentioned. In this case, the value of standards established, based on their average value in this set and trends of there changes. A characteristic feature of the integral indicator I_j is that its value is in the range from 0 to 1. Interpretation of this indicator is as follows: it takes high values when values of indicators in the system are close to the standard and low values when values of indicators in the system are far to the standard [10].

To calculate the integral indicators of innovative activity (I_x) the above logic of computing taxonomic indicators in Excel spreadsheet was applied. To build a taxonomic indicator of innovation activity specific indicators were identified as: x_1 – knowledge-intensity of production; x_2 – updating products; x_3 – coefficient of new products introduction; x_4 – products' exportability; x_5 – share of fundamentally new products; x_6 –share of new products for the enterprise.

To build a taxonomic indicator of the effectiveness of innovative expenses (I_y) specific indicators were identified as: y_1 − share of R&D expenses in total production costs; y_2 – share of expenses on means of labor and equipment purchases; y_3 –share of expenses on research and development; y_4 – specific weight of own sources of funding; y_5 –coefficient of innovation costs performance. Table 1 contains

the values of the integral indicator of innovation costs performance for the period 2008-2012 for each surveyed enterprise.

Since the integral indicators measured in a range from 0 to 1, it is advisable to the value of general indicator of innovative activity performance by dividing the value of the integral indicator of innovative activity by the value of the integral indicator of innovation costs effectiveness.

Table 1

The value of integral indicators in enterprises surveyed for 2008-2012

Enterprise	Year	I_x	I_y	I_e
OJSC «Turboatom»	2008	0,426	0,075	5,681
	2009	0,428	0,354	1,207
	2010	0,483	0,348	1,388
	2011	0,400	0,303	1,321
	2012	0,549	0,365	1,505
SSPE “Kommunar Corporation”	2008	0,234	0,089	2,632
	2009	0,187	0,279	0,669
	2010	0,491	0,281	1,752
	2011	0,444	0,233	1,907
	2012	0,274	0,261	1,050
SEP “Electrotyazhmash”	2008	0,419	0,187	2,242
	2009	0,491	0,326	1,508
	2010	0,005	0,221	0,023
	2011	0,427	0,281	1,518
	2012	0,392	0,262	1,495
Puat “Svitlo Shahtary”	2008	0,254	0,193	1,317
	2009	0,257	0,224	1,149
	2010	0,294	0,304	0,967
	2011	0,298	0,228	1,305
	2012	0,315	0,283	1,111
PJSC “Yuzhcable works”	2008	0,384	0,419	0,917
	2009	0,297	0,438	0,678
	2010	0,510	0,427	1,195
	2011	0,372	0,424	0,877
	2012	0,394	0,483	0,816
JSC “Kharkiv Tractor Plant”	2008	0,284	0,307	0,924
	2009	0,426	0,281	1,517
	2010	0,366	0,136	2,693
	2011	0,284	0,180	1,577
	2012	0,364	0,250	1,457
SPC “FED”	2008	0,429	0,237	1,814
	2009	0,440	0,212	2,076
	2010	0,457	0,152	3,000
	2011	0,500	0,169	2,960
	2012	0,254	0,143	1,770

Source: Developed by the author

To build the model of dependence of the general indicator of innovation activity effectiveness from the factors that determine the human resources innovative potential, follow factors used: z_1 –- share of scientists with academic degrees in the total R&D personnel; z_2 – ratio scientific intensity of employees; z_3 – average salary of R&D personnel; z_4 – share of R&D personnel salary to total salary of all employees; z_5 – share of R&D personnel salary to total expenditures on innovation activity; z_6 – share of R&D personnel salary to the volume of innovative products sold. It’s advisable to calculate a multifactorial linear model of dependence of the general indicator of innovation activity effectiveness, using regression analysis − to use an stepwise regression analysis or incremental sequential regression exclusion factors with the module Stepwise Variable Selection of the special statistical package Statgraphics Centurion. As a result of these calculations multifactor linear regression model obtained:

$$I_e = 1{,}5894 - 1{,}329z_1 - 26{,}541z_2 - 0{,}04z_3 + 7{,}893z_4 + 4{,}27z_5 + 0{,}237z_6,$$

$$t_a = 1{,}8 \quad t_{b_1} = -0{,}27 \; t_{b_2} = -1{,}10 \; t_{b_3} = -1{,}3 \; t_{b_4} = 0{,}54 \quad t_{b_5} = 2{,}46 \; t_{b_6} = 0{,}04.$$

Calculated Student's statistics show that only one factor z_5 – share of R&D personnel salary to total expenditures on innovation activity is significant, and all the rest are not important, and therefore do not affect the change of resulting feature. The coefficient of determination shows that the variability of general indicator of innovation activity effectiveness is explained on the 22.365 % by variability of factors included in the model. According to the Durbin-Watson's statistics, autocorrelation residues tested. The test confirmed its existence. Therefore the model built is not recommended for forecasting use. According to the Fisher's criterion $F = 1{,}34$ the model is significant as a whole.

According to Student's statistics the model of dependence of the general indicator of innovation activity effectiveness from the factors that determine the human resources innovative potential of the six features included in the model, only one factor − share of R&D personnel salary to total expenditures on innovation activity (z_5) has significant impact on the result.

Here is multifactor linear regression model in which only significant factors left:

$$I_e = 0{,}536 + 3{,}462z_5,$$

$$t_{b_5} = 2{,}289.$$

The coefficient of determination shows that the variability of general indicator of innovation activity effectiveness due to the variability of share of R&D personnel salary to total expenditures on innovation activity by 13.708% and other factors included in the model. According to Durbin-Watson' statistics, autocorrelation residues tested. Test confirmed its existence, then the model built is not recommended for forecasting use. According to the Fisher's criterion $F = 5{,}24$ the model is significant as a whole.

Thus, in the calculated model the regression coefficient indicates that if the share of R&D personnel salary to total expenditures on innovation activity changed by 0.1 then result changed by 0.3462.

Conclusions and further research. The results of the economic and mathematical modeling show that the share of R&D personnel salary to total expenditures on innovation activity significantly affects the effectiveness of innovative activity, confirming the importance of remuneration level of innovative employees in ensuring the success of innovation activity. It actualizes the problem of the development of effective programs intensifying the work of innovative employees with a focus on ensuring an adequate level of remuneration for achieving high innovation results.

Summarizing the results of the research, the leaders in innovation activity performance during the period studied were OJSC «Turboatom». This especially is true for 2008, when the indicator is fixed at the level of 5.681. The worst position takes PJSC "Yuzhcable works", for which the maximum was recorded only in 2010 at 1,195, while in other years even 1 was not reached. In addition, the level of the most influential indicator − the share of R&D personnel salary to total expenditures on innovation activity − at that company was also the lowest among all the studied companies.

Thus, the situation regarding the innovative activity performance at industrial enterprises can be described as unfavorable − the studied indicators show a chaotic tendency, often to the downside. Taking into account the significant influence of the indicator of innovative employees remuneration on the success of exercised their innovation activity, modern managers should pay attention to program of development and promotion of innovative activities, including their material constituent. In addition, it is obligatory to take into account features of labor behavior of this category of employees, their value orientations, related needs and opportunities to meet them at a certain company. Only under these conditions, the implementation of these programs will contribute to the achievement of expected results.

References

1. Antoniuk, L.L. (2007), *Aktualni problemy innovatsiynoho rozvytku Ukrainy na suchasnomu etapi* [Actual problems of innovative development of Ukraine on the modern stage], monograph, *NAN Ukrayiny. In-t ekonomiky promyslovosti*, Donetsk, Ukraine, 328 p.

2. Khariv, P.S., Sobko, A.M. (2003), *Aktyvizatsiia innovatsiinoi diialnosti promyslovykh pidpryiemstv rehionu* [Activation innovative activity of industrial enterprises in the region], TANH, Ternopil, Ukraine, 180 p.

3. Petrova, I.L., Shpylova, T.I. and Sysolina, N.P. (2010*), Innovatsiina diialnist: stymuly ta pereshkody* [Innovative activity : Incentives and barriers], monograph, Dorado, Kyiv, Ukraine, 320 p.

4. Trifilova, A.A. (2005), *Otsenka effektivnosti innovatsionnogo razvitiya predpriyatiya* [Evaluating the effectiveness of innovative development of enterprise], Finansy i Statistika, Moscow, Russia, 304 p.

5. Koiuda, V., Lysenko, L.A. (2010), *Innovatsiina diialnist pidpryiemstva ta Otsinka ii efektyvnosti* [Innovation activities of enterprises and assessing its efficacy], monograph, Kh.: FOP Pavlenko O.H.; VD "INZHEK", Kharkiv, Ukraine, 224 p.

6. Didukh, D.M. (2012), «The indicator system analytical support innovation management company», available at: http://znau.edu.ua/visnik/2012_2_2/78.pdf

7. Piliavoz, T.N. (2012), “Methodological approaches for assessing innovative development company”, available at: http://economy.nayka.com.ua/?op=1&z=1085&p=1

8. Yokhna, M.A. and Stadnyk, V.V. (2005), *Ekonomika i orhanizatsiia innovatsiinoi diialnosti* [Economics and organization of innovative activity], tutorial, Vydavnychyy tsentr «Akademiia», Kyiv, Ukraine, 400 p.

9. Maliarets, L. (2006), *Vymiriuvannia oznak obiektiv v ekonomitsi: metodolohiya ta praktyka* “Measuring attributes of the objects in Economics: Methodology and Practice : scientific publications”, Kharkiv : Vyd. KHNEU, Kharkiv, Ukraine, 384 p.

10. Ponomarenko, V.S. and Maliarets, L.M. (2009), *Analiz danykh u doslidzhenniakh sotsialno-ekonomichnykh system* [The analysis of data in studies of socio-economic systems], monograph, Kharkivskyi natsionalnyi ekonomichnyi un-t, Kh. : VD "INZHEK", Kharkiv, Ukraine, 432 p.

Senichkina O.Ye. DETECTION OF EFFECTIVENESS FACTORS IMPACT ON INNOVATIVE ACTIVITY OF INDUSTRIAL ENTERPRISES

Purpose of the article is to determine the effectiveness of the innovation activity of certain industrial enterprises of Kharkov region and identify factors which influencion of innovation potential personnel bythem**.**

Methodology of research. To achieve this goal such methods of researchhave been used: theoretical generalizations system analysis and scientific clasification- for identifying key indicators for assessing innovtsiynoyi of enterprises; statistical analysis - to assess the status of innovation activity of industrial enterprises of Kharkov region; method of summarizing evaluations - to build integrated indicators to measure the impact of innovation activity; method of factor analysis - to determine the factors influencing effectiveness of innovation. The theoretical basis of scientific work is work of domestic and foreign scientists. The information base is the official statistics, materials of the State Statistics Committee of Ukraine, the data reporting industrial enterprises in Ukraine and Kharkiv region.

Findings. The main indicators for assessing the innovation activities of enterprises are determined. An assessment of the innovative activity of industrial enterprises in Kharkiv region is conducted. Powered integrated performance evaluation of innovation. The factors influences the effectiveness of innovation activity are determined.

Originality. The procedure for evaluating the impact of innovative activity of industrial enterprises, which, unlike existing envisages grouping indicators for innovation activity and efficiency of innovation costs are substantiated.

Practical value. The practical value is the calculation of integrated indicators, which gives the opportunity to explore the general state of innovation activity and identify the impact of factors of efficiency of generalizing integral indicator of innovative activity.

Key words: innovation acting, integrated performance, innovative activity, the impact of innovation activities