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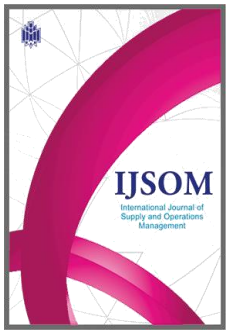

An Approach to Innovation Potential Evaluation as a Means of Enterprise Management Improving

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Abstract
Complexity of the enterprise innovative potential as a subject of research and its multifaceted nature cause a large number of approaches to its evaluation. Therefore, an urgent area of research is the development of a comprehensive approach that would promptly and fully diagnose the state of existing innovation potential of the enterprise. This article proposes a methodology for innovation potential evaluation is proposed, based on the resource and productive approaches to its measurement. In accordance with the proposed integrated approach, the following evaluation goals are identified: analysis of the efficiency of using innovative potential and determining the degree of relevance between the existing innovation potential and the selected enterprise development strategy (or new innovation project). As a result of the conducted research, the most informative indicators, characterizing the constituent elements of the innovation potential, have been determined, and on the basis of their use a method of calculating the final indicators of utilization efficiency and relevance of the existing innovation potential of the enterprise has been developed.

Keywords: Innovation potential; Management; Efficiency; Relevance; Factor analysis; Geometric addition method.

1. Introduction

Keeping active innovative activity ensures the overall development of entrepreneurship, as well as improving (or maintaining at the required level) its competitiveness. At the same time conducting innovation activities is accompanied by significant risk due to the stochastic nature of innovations. Innovation management is called to reduce the degree of this risk. It consists of a number of stages, the central of which is to make management decisions on the choice and implementation of a particular development strategy and specific strategy. Management decisions are not possible without reliable and complete information about the object of management. In its turn, the definition of enterprise development strategy depends on the main characteristics of the existing innovation potential of the enterprise, which is a necessary condition for innovation and acts as a significant factor in increasing the competitiveness of the enterprise. Therefore, in order to objectively evaluate the current situation, find competitive advantages and improve the management of the company as a whole, it is necessary to analyze the existing innovation potential and identify reserves for improving its efficiency. The subject of research and analysis is the innovative potential of the enterprise and its components. The main purpose of the article is to formulate and justify a comprehensive approach to evaluating the innovative potential of the enterprise.

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The scientific works of many scientists are devoted to the study of the essence of innovative potential of the enterprise and methods of its evaluation. Thus, the concept of innovation potential was first introduced into the scientific circulation by Freeman (1982). According to (Freeman, 1982), innovation potential is an opportunity, a means and a stock which can be activated and used to solve problems connected with creation of innovations for the purpose of growth of economic system. Drucker (1993) studied the practical aspect of innovation potential. The scientist believed that innovation begins with an analysis of existing potential for its effective use (Drucker, 1993). Balázs (1995) evaluated the potential of new organizational forms of management and understanding of their functioning in newly created innovation systems in order to enhance the flow of knowledge into the industry account of academic and university studies. Hung and Mondejar (2005) in their scientific work presented the results of the study of the connection of corporate governance with the development of innovation potential of enterprises in a large Asian city. In an article by Kokkonen and Tuohino (2007) it was confirmed that innovations in the networks of tourism enterprises are a synthetic process consisting of interconnections of innovative products, processes and resources. Because of that, researchers (Kokkonen and Tuohino, 2007) have found that the links between these businesses with universities have increased their innovative potential and creativity in the sphere of making innovative products. Khilji, Mroczkowski and Bernstein (2006) proposed an approach to evaluating the innovation potential of biotechnology enterprises, which is of particular importance to these companies because it takes into account the complexity of managing a long industry development cycle and the high level of competition between enterprises. Harris, McAdam & Reid (2016) have found that implementing measures to improve enterprise management in peripheral regions helps to reduce the level of innovation potential development in enterprises operating in these regions. The article of Shao, Hu, Cao, Yang & Guan (2020) is dedicated to the features study of the impact of environmental regulation on the innovation potential of enterprises. Rosa (1998) presents the results of a case study of the life histories and business genealogies of ordinary entrepreneurs who own highly developed businesses in Scotland. The author (Rosa, 1998) reveals the diversity of experience of the researched entrepreneurs, types of start-ups, as well as strategies designed to create effective innovative potential of the enterprise. The study of Turkina, Oreshkin, and Kali (2013) focuses on the empirical analysis of effectiveness of the performance of individual enterprises within innovative clusters, which found that communication with other cluster participants (enterprises, research institutions, universities) helps these firms to overcome the negative effects placement in clusters and to enhance the effectiveness of its innovation potential as a whole. In paying tribute to the completed research, it should be noted that they do not reflect a comprehensive approach to research the problem of evaluating the innovation potential of the enterprise. This gap in the theory and practice of management is to be filled by the methods of evaluateing the innovative potential of the enterprise, which will allow to make rational management decisions and manage effectively not only innovation activity, but also the enterprise as a whole.

2. Research methods

Complexity of the enterprise innovative potential as a subject of research and its multifaceted nature cause a large number of approaches to its evaluation. Thus, there are resources, results and diagnostic groups of approaches, which include in their composition various methods of evaluation of innovative potential, which, in their turn, determine the basic parameters of the relevant methodological approach (Kuksa, Hnatenko, Orlova-Kurilova, Moisieieva and Rubezhanska, 2019). We consider it advisable to offer a comprehensive approach to evaluating the innovation potential of the enterprise, which is based on the resources and productive approaches to its measurement, and allows to conduct a quickly and fully diagnostic of the state of the existing innovation potential of the enterprise. According to the proposed approach, methods for evaluating innovation potential should be based on a system of interrelated indicators and be targeted. That is why the following evaluation goals have been identified: to analyze the effectiveness of using innovative potential and the contribution of its elements to the overall result of the enterprise functioning, as well as to determine the degree of relevance between the available innovation potential and the chosen enterprise development strategy (or innovation project). Achieving the first of these evaluation goals involves the use of performance criteria and quantitative indicators that allow to integrate as much as possible with the enterprise accounting system (or serve as the basis for its creation). The method of calculating the indicator of the efficiency of the innovative potential use based on the implementation of factor analysis using the method of chain substitutions is universal in nature and can therefore be recommended for evaluation by different enterprises. The second objective can be achieved by using qualitative and quantitative indicators and appropriate methods of processing them in order to calculate an aggregate indicator of relevance based on the graphical addition method. This indicator makes it possible to compare the existing innovation potential of a particular enterprise with its current development strategy (or new innovation projects), as well as to compare the innovation potentials of different enterprises.

3. Research results and discussion

The use of a comprehensive approach for evaluation allows to obtain a complete description of the innovation potential of the enterprise (hereinafter - IP), necessary for the informed decision making of strategic and operational decisions regarding the implementation and development of existing IP, as well as to improve the management of the enterprise as a whole. The architectonics of this approach is reflected in Figure 1.

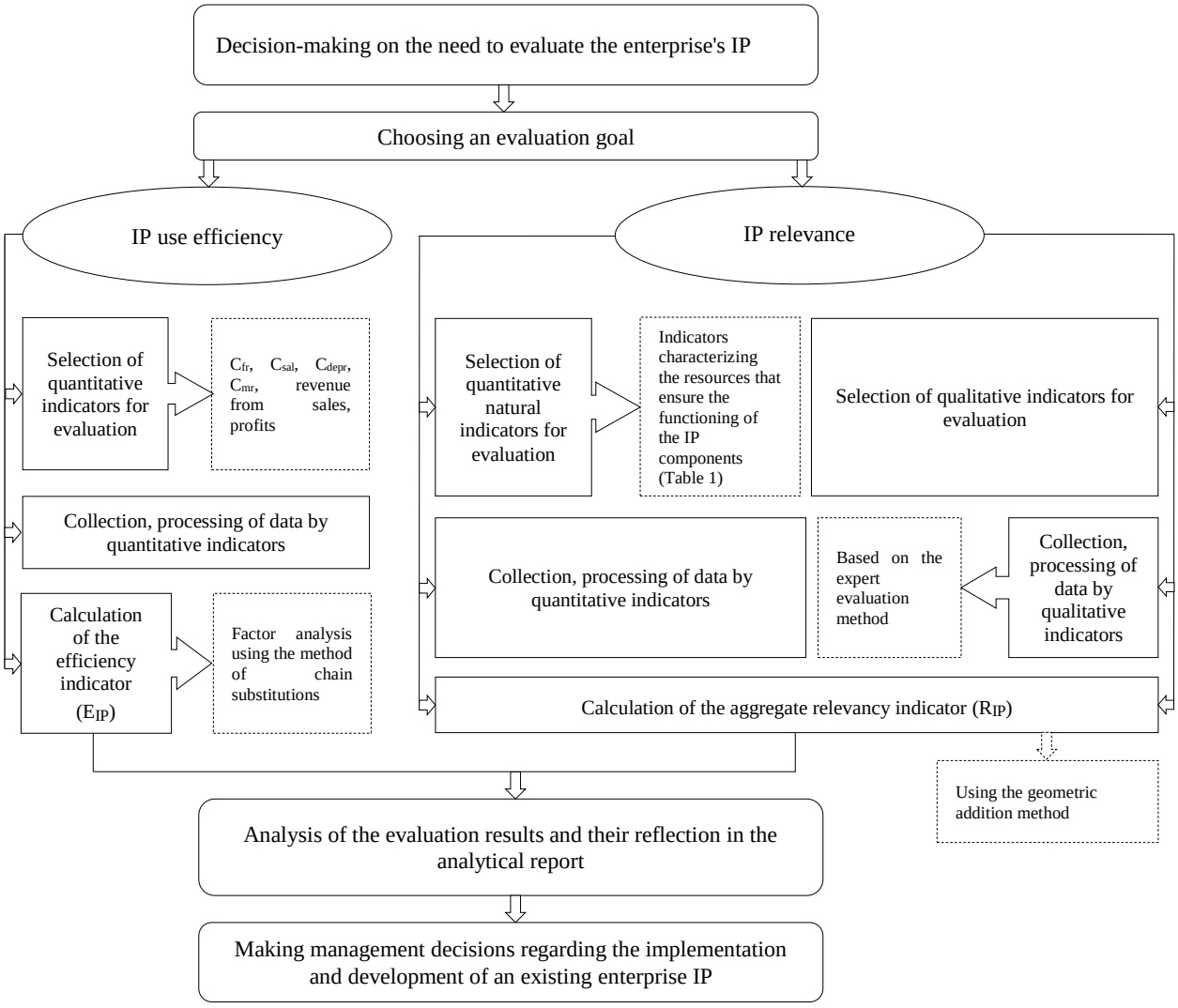

Figure 1. Architectonics of a comprehensive approach to enterprise IP evaluation

The algorithm of the complex approach, shown in Figure 1, is a set of successive stages, directly subordinated to the main goals of evaluating the enterprise's IP: determining the efficiency of use and relevance to future directions of innovative development of the enterprise. According to the above-mentioned algorithm, the next stage after making a decision on the enterprise's IP evaluation is the stage of the evaluation goals selection. We consider a conditional variant in which performance and relevancy are separate processes. In practice, depending on the need for granularity of information to make a decision, these processes can proceed simultaneously. Methods of calculating the IP efficiency (subparagraph 3.1) and the indicator of the relevance of the existing IP of the enterprise (subparagraph 3.2) will be considered in more details.

3.1. Calculation of the IP efficiency Indicator (E_{ip})

In our opinion, the enterprise's IP efficiency is the ratio of the effect obtained from the implementation of activities using innovative technologies to the costs incurred for this labor, financial, material and technical (information and technological) resources (Kuksa, Shtuler, Orlova-Kurilova, Hnatenko and Rubezhanska, 2019). Therefore, for the implementation of the indicated direction of evaluation, we suggest to use the ROI (Return on Investment) indicator. At the same time, the conclusion about the effective use of a business entity IP can be made if the obtained values of return on IP costs are positive and increase in dynamics. The proposed methodology also allows to calculate and estimate the magnitude of the impact of each component of IP on the change in the overall efficiency of its use, which makes it possible to increase the positive impact of some factors in a timely manner and minimize the negative impact of others. To build a factor model for calculating the effectiveness of IP, an indicator (E_{IP}), is used that characterizes the amount of IP resources that was spent to obtain $ 1 profit (1):

$$E_{IP} = \frac{The\ cost\ of\ IP\ resources}{Product\ Revenue} \quad (1)$$

Making certain transformations, a factor model of the following form is obtained (2):

$$E_{IP} = \left(\frac{C_{sal}}{\text{income}} + \frac{C_{mr}}{\text{income}} + \frac{C_{dep}}{\text{income}} + \frac{C_{fr}}{\text{income}}\right) * \frac{\text{income}}{\text{profit}} = \left(K_{sal} + K_{mr} + K_{dep} + K_{fr}\right) * \frac{1}{ROS} \quad (2)$$

where:
C_{sal} – costs for salary;
C_{mr}– costs for material resources;
C_{dep}– depreciation costs for fixed assets (costs for IT resources);
C_{fr}– costs for financial resources
ROS– profitability of sales;
K_{sal}– salary ratio;
K_{mr}– material ratio;
K_{dep}– depreciation ratio;
K_{fr}– capacity of financial resources, determined by the formula (3):

$$K_{fr} = \frac{\text{Expenditures on current activities} + \text{Purchased fixed assets}}{\text{Revenue from sales of products}} \quad (3)$$

Thus, a mixed-type factor model was obtained. To evaluate the impact of each factor on the resultant indicator in this system, we apply the method of chain substitutions:

$E_{IP0} = \left(K_{sal0} + K_{mr0} + K_{dep0} + K_{fr0}\right) * \frac{1}{ROS_0}$, and accordingly $E_{IP1} = \left(K_{sal1} + K_{mr1} + K_{dep1} + K_{fr1}\right) * \frac{1}{ROS_1}$.
Then $\Delta\, E_{ip} = E_{ip1} - E_{ip0}$.

where:
E_{IP0}, K_{sal0}, K_{mr0},K_{dep0},K_{fr0}, ROS_0 – indicators of the previous period;
E_{IP1}, K_{sal1}, K_{mr1},K_{dep1},K_{fr1}, ROS_1 – indicators of the reporting period.

Determining the size of the impact of each factor on the resulting indicator of the effectiveness of the use of IP:

$E'_{\text{IP}} = \left(K_{sal1} + K_{mr0} + K_{dep0} + K_{fr0}\right) * \frac{1}{ROS_0}$, then, under the influence of this factor (K_{sal}), the resulting indicator will change: $\Delta\, E_{\text{IP}}^{sal} = E'_{\text{IP}} - E_{\text{IP0}}$;
$E''_{\text{IP}} = \left(K_{sal1} + K_{mr1} + K_{dep0} + K_{fr0}\right) * \frac{1}{ROS_0}$, then: $\Delta\, E_{\text{IP}}^{mr} = E''_{\text{IP}} - E'_{\text{IP}}$;
$E'''_{\text{IP}} = \left(K_{sal1} + K_{mr1} + K_{dep1} + K_{fr0}\right) * \frac{1}{ROS_0}$, then: $\Delta\, E_{\text{IP}}^{dep} = E'''_{\text{IP}} - E''_{\text{IP}}$;
$E''''_{\text{IP}} = \left(K_{sal1} + K_{mr1} + K_{dep1} + K_{fr1}\right) * \frac{1}{ROS_0}$, then: $\Delta\, E_{\text{IP}}^{fr} = E''''_{\text{IP}} - E'''_{\text{IP}}$;
$E'''''_{\text{IP}} = \left(K_{sal1} + K_{mr1} + K_{dep1} + K_{fr1}\right) * \frac{1}{ROS_1}$, then: $\Delta\, E_{\text{IP}}^{ROS} = E'''''_{\text{IP}} - E''''_{\text{IP}}$.

Thus, the performance of enterprise IP evaluation based on factor analysis enables all interested parties to evaluate the degree of impact of each component of innovation potential on the efficiency of its use, as well as to adjust the results of the analysis of the policy of innovation activity management in order to increase the positive impact of one factor and minimize the negative impact of the others.

3.2. Calculation of the aggregate indicator of IP relevance (R_{ip})

Relevant IP of the enterprise represents the potential, the capabilities of which meet the conditions for achieving the desired goals, the content of the functions performed in the process of innovation, the current strategy of company development, as well as the requirements of innovative projects in each case. Therefore, determining the degree of IP relevance is an important area of evaluation. The essence of calculating the degree of relevance of IP is to determine the level of provision of all components of IP with a certain amount of resources needed to implement the current strategy of innovative development (or to implement a specific innovation project). In the process of calculating the relevance of IP, the most methodological difficulty is to determine the number and composition of qualitative, and in some cases, quantitative indicators characterizing the resources (labor, financial material, information and technological) that ensure the functioning of components of enterprise IP. The solution to this problem is closely linked to the plans of the management of each individual enterprise strategy for the development and use of existing IP. It is impossible to consider in the framework of this study all possible strategies and projects as well as to take into account the specifics of the activities of thousands of innovative enterprises without violating the universality of the proposed integrated approach to IP evaluation. Therefore, we propose for each component of the enterprise's IP a general list of possible quantitative indicators, which may vary on a case-by-case basis to supplement or reduce, depending on the particular features of innovation activity of a particular enterprise. The calculation of these indicators is carried out using conventional

mathematical formulas. The list of quantitative indicators that can be used in determining the relevance of IP is shown in Table 1.

Table 1. List of possible quantitative indicators for determining the relevance of enterprise IP

Resources	Components of enterprise IP				
	Intelligent	Research	Production and technical	Organizational and management	Marketing
Labor	Indicator of correspondence of existing personnel to staff schedule; indicator of personnel turnover; indicator of personnel rotation	Percentage of workers employed in the enterprise's innovation units; share of workers employed in innovative units of higher education enterprises; share of workers employed in the innovation units of the enterprise with scientific degrees	Share of the number of personnel directly employed in the production; correspondence of the average category of workers to the average category of work	Share among organizational and management staff of specialists with higher specialized management education; coefficient of readiness of organizational and management personnel for innovations	Share of staff engaged in innovation commercialization;
Financial	Payroll fund; indicator of effective use of the fund of working time	Indicator of enterprise investments in preparation and advanced training of scientific and engineering-technological personnel;	Indicator of financing of innovative sphere of enterprise activity; share of costs for pilot production	Share of own funds spent on financing innovative projects; the level of increase in the financial liquidity of the balance sheet	Indicator of the organization's cost to commercialization innovation and technology transfer
Material	Funding of workers' labor; indicator of technical equipment of labor of workers	Fund return; the intensity of research; material intensity of research works;	Cost of fixed assets; cost of materials; the cost of specialized equipment; factor of updating of fixed assets; utilization ratio of fixed assets; material utilization rate;	Asset cost per manager; cost of computer equipment per manager	Employee Commercialization Ratio of Innovation modern office equipment, mobile phones, Internet access
Information technology	Information implementation of workers labor	Number of scientific and technical library funds; the amount of expenditure on scientific and technical information; indicator of the intensity of use of scientific and technical information; coefficient of automation of research works	Intensity of use of information assets; the level of use of information assets for production needs	The degree of satisfaction of information needs; coefficient of completeness of information support; Internet usage rate;	The economic effect of the invention, the level of use of consumer information; the level of use of patent information

It should be separately emphasized that the proposed system of quantitative indicators does not claim to be the comprehensive one. The development and systematization of quantitative indicators used in the evaluation of enterprise IP is a promising area for further research.

The volume and composition of qualitative indicators for the calculation of the aggregate indicator of IP relevance depends directly on the specificity of the innovation activity of the enterprise (innovation project). Therefore, the list of these indicators can be infinitely long, so it is pointless to give all the qualitative indicators characterizing IP. We consider it advisable to carry out the evaluation of qualitative indicators with the help of expert methods, in the framework of

which the issues of choosing the number of experts, their composition, scale of evaluations and methods of processing the results are solved.

The final step in a comprehensive approach to IP evaluation is to calculate an aggregate indicator of IP relevance. This indicator is of considerable interest when comparing the IP of several enterprises among themselves to decide on the choice of one of them for the implementation of a specific innovation project. The calculation of the aggregate indicator of relevance is associated with great methodological difficulties, which are to compare and evaluate relative to each other different quantitative and qualitative quantities. To solve this problem, we consider it advisable to use the method of geometric assembly. To use this method, the number of IP relevance indicators must be equal to four. Each indicator has its own measuring scale with its dimension (percentages, coefficients, integers, etc.), scale and limits of indicators. For four indicators, a corresponding graph is constructed in the form of a square (Figure 2), each side of which is a measuring scale for fixing the value of a particular indicator at a certain point in time.

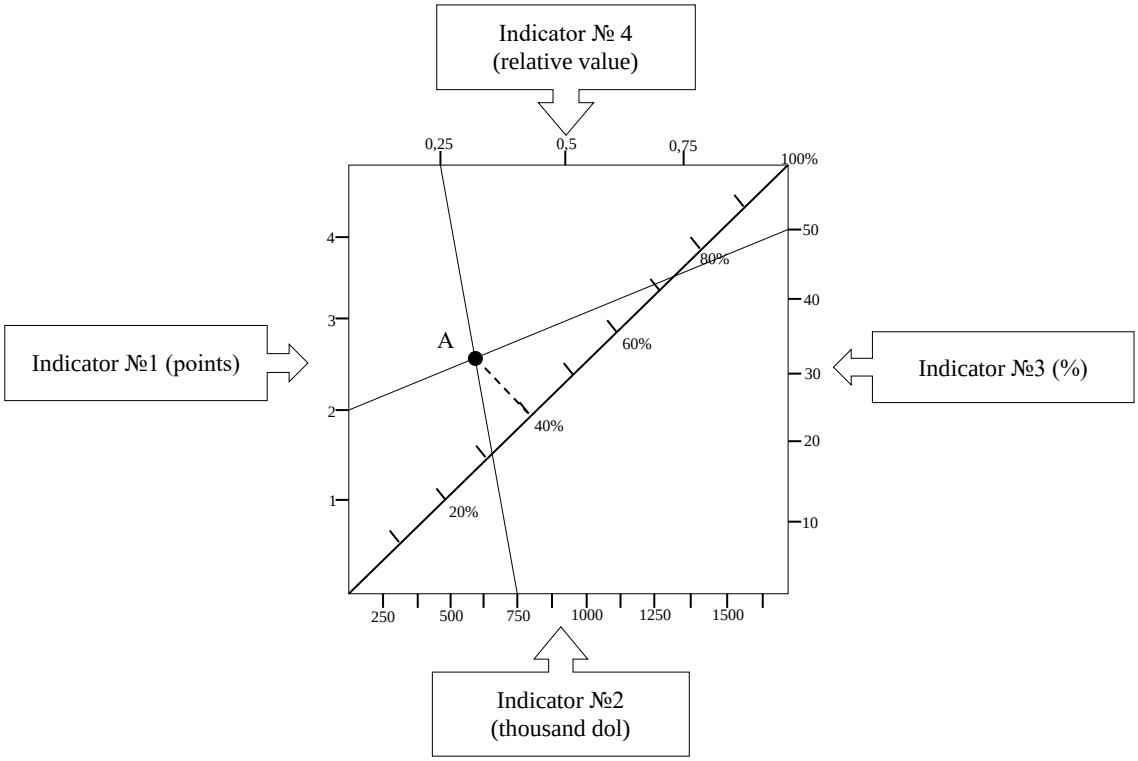

Figure 2. An example graph of determining an aggregate index of IP relevance based on the geometric addition method

Based on the schematic illustration in Figure 2 of the example of the geometric addition method use, the technique of obtaining an aggregate index of relevance IP can be described as follows. The corresponding measurement scales (sides of the square) capture the values of indicators at a certain point in time. The fixed values on opposite sides of the square are joined by straight lines whose intersection point (A) characterizes the aggregate relevance of IP. If at any point in time the values of all indicators reach the threshold positive values, then the intersection point will move to the upper right corner. This will mean the maximum value of aggregate relevance of IP. By plotting another scale (diagonal) with gradations from 0 to 100 and lowering the perpendicular from the point of intersection to this scale, we can get the degree of relevance of IP at this point in time.

It should be emphasized separately that the application of the method of geometric addition is possible with any number of indicators. So, if the number of indicators is less than 4, for example 3, then one of them is duplicated on the perpendicular side of the square graph. With more of them, separate graphs are built for each group of indicators. After that, the resulting graph is constructed, on the axes of which the relevance of each group of 4 indicators is marked, but not the individual indicators.

The interpretation of the results of the aggregate indicator calculation of enterprise IP relevance can be demonstrated as follows:
0-20% - critically low degree of relevance of IP, (all components of IP have a negative tendency, innovative capabilities of the enterprise are extremely low);
20-40% - low degree of relevance of IP, (several components of IP have a negative tendency, all other components are stable, innovative capabilities of the enterprise are low);
40-60% - average degree of relevance of IP, (all components of IP are stable, there is no positive or negative dynamics, innovation capabilities of the enterprise are average);

60-80% - sufficient degree of relevance of IP, (several components of IP have a positive tendency, all other components are stable, the enterprise has sufficient opportunities to carry out effective innovation activity (successful implementation of the innovation project));
80-100% - high degree of relevance of IP, (all components of IP have a positive tendency, the company has high opportunities for effective innovation (successful implementation of the innovation project)).

Thus, an aggregate indicator of relevance, calculated as part of a comprehensive approach to the enterprise IP evaluation, provides an opportunity to make informed conclusions about the adequacy of the level of providing all components of the enterprise with the resources necessary for the implementation of a specific strategy of innovative development of the enterprise, implementation of a specific innovation project, conducting innovative activity as a whole.

4. Conclusion

Developed method in this study, a comprehensive approach to evaluating existing IP allows to diagnose the latter in advance and make appropriate management decisions to improve and further develop its components. The proposed method of evaluation is based on the calculation of indicators of relevance and efficiency of the innovative potential of the enterprise. In this case, the aggregate indicator of relevance allows to compare the existing innovation potential of a particular enterprise with its current development strategy (or new innovative projects), as well as to compare the innovation potentials of different enterprises. The factor model for evaluating potential utilization enables all stakeholders to evaluate the impact of each component of IP on the efficiency of its use, as well as to adjust the innovation management policies to maximize the positive impact of some factors and minimize the negative impact of others. The proposed integrated approach to the evaluation of IP is universal and may therefore be recommended for use by different enterprises in the process of diagnosing the status of existing IP.

References

Balázs K. (1995). Innovation Potential Embodied in Research Organizations in Central and Eastern Europe. *Social Studies of Science,* Vol. 25(4), pp. 655–683.

Drucker P. (1993). *Innovation and Entrepreneurship,* London: Harper Collins Publishers Ltd.

Freeman Ch. (1982). *Economics of Industrial Innovation,* Second ed., London: Pinter.

Harris R., McAdam R. and Renee Reid R. (2016). The effect of business improvement methods on innovation in small and medium-sized enterprises in peripheral regions. *Regional Studies,* Vol. 50(12), pp. 2040-2054.

Hung H. and Mondejar R. (2005). Corporate directors and entrepreneurial innovation: an empirical study. *The Journal of Entrepreneurship,* Vol. 14(2), pp. 117–129.

Kokkonen P. and Tuohino A. (2007). The challenge of networking: analysis of innovation potential in small and medium-sized tourism enterprises. *The International Journal of Entrepreneurship and Innovation,* Vol. 8(1), pp. 44-52.

Kuksa I., Hnatenko I., Orlova-Kurilova O., Moisieieva N. and Rubezhanska V. (2019). State regulation of innovative employment in the context of innovative entrepreneurship development. *Management Theory and Studies for Rural Business and Infrastructure Development,* Vol. 37(2), pp. 228-236.

Kuksa I., Shtuler I., Orlova-Kurilova O., Hnatenko I. and Rubezhanska V. (2019). Innovation cluster as a mechanism for ensuring the enterprises interaction in the innovation sphere. *Management Theory and Studies for Rural Business and Infrastructure Development,* Vol. 41(4), pp. 487-500.

Rosa P. (1998). Entrepreneurial processes of business cluster formation and growth by 'habitual' entrepreneurs. *Entrepreneurship Theory and Practice,* Vol. 22(4), pp. 43-61.

Shaista E., Mroczkowski Kh. and Bernstein B. (2006). From invention to innovation: toward developing an integrated innovation model for biotech firms. *Journal of Product Innovation Management,* Vol. 23, pp. 528-540.

Shao Sh., Hu Zh., Cao J., Yang L. and Guan D. (2020). Environmental regulation and enterprise innovation: a review. *Business Strategy and the Environment,* Vol. 29(1), pp. 1-14.

Turkina E., Oreshkin B. and Kali R. (2019). Regional innovation clusters and firm innovation performance: an interactionist approach. *Regional Studies,* Vol. 53(8), pp. 1193-1206.