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**OSTROVSKA Halyna**

PhD (Economics), Associate Professor,  
Ternopil Ivan Pul'uj National Technical University,  
Ternopil, Ukraine

ORCID ID: <https://orcid.org/0000-0002-9318-2258>

e-mail: h.ostrovska@gmail.com

## MODELING OF INTELLECTUAL POTENTIAL MANAGEMENT SYSTEM OF INDUSTRIAL ENTERPRISE

*The article is devoted to the development of the intellectual potential management system taking into account its hidden opportunities in order to increase the competitiveness of domestic industrial enterprises in the conditions of knowledge-based economy formation. An adaptive and rational approach to the development of the intellectual potential management system has been proposed. An algorithm for increasing the competitiveness of industrial enterprises based on the effective use of intellectual potential through the detection and implementation of hidden opportunities for innovation has been developed. It has been substantiated that as a result of intellectual potential management system realization taking into account the revealed new ideas, besides economic effect such kinds of effect as scientific, technological, social, information, ecological, etc. can be received. It has been proved that the increase of intellectual potential management of the enterprise efficiency can be reached as a result of continuous search hidden ideas at all stages of innovation life cycle and at all stages of the enterprise activity.*

**Keywords:** *intellectual potential, industrial enterprise intellectual potential management system, organizational mechanism for managing the intellectual potential of an industrial enterprise, hidden potential of innovations.*

**Introduction.** In modern conditions, the problem of industrial enterprises intellectual potential effective use is becoming increasingly practical. Further innovative development of enterprises, as well as economic and technological security of the state depends on the prompt solution of this problem. Experts are solidar in fact, that a small number of domestic industrial enterprises have a strong intellectual potential, as they are not able to manage it effectively, which negatively affects the efficiency of their innovation activity. The existing system of intellectual potential management is characterized by the focus on weaknesses eliminating due to the available resources of the enterprise. It practically does not provide for the mobilization of additional opportunities for this potential, hidden in new technical, technological and organizational solutions. The implementation of ideas and opportunities hidden in innovation, which is a source of new value and has the status of one of the main operational and strategic competitiveness factors, can provide new prospects for innovative development of enterprises.

**Literature review.** Problems in the context of intellectual potential management have been studied by domestic experts of both scientific and business communities: B. Andrushkiv, O. Butnik-Siversky, V. Geyets and A. Gritsenko, H. Pylypenko and N. Fedorova, O. Kuzmin and L. Lipich, L. Maliuta and R. Sherstiuk, A. Nalyvayko and O. Grebeshkova, Y. Sytnyk, O. Sobko, and others.

In this context, B. Andrushkiv summarizes the directions of intellectual potential of the enterprise effective use as a means of entering the European economic space [1]. O. Butnik-Siversky substantiates the expediency of neo-economy forming in the field of intellectual property from the standpoint of intensification processes [2]. Socio-class transformations and the formation of a new education quality, science and innovationvs as of the Ukrainian economy reconstructive components development have been actively studied [3-4]. O. Kuzmin and L. Lipich study the methodological aspects of intellectual potential management concept as a tool to increase the competitiveness of the enterprise [5]. L. Maliuta and R. Sherstiuk outline the realities and prospects of effective of Ukrainian intellectual potential use in a knowledge-based economy [6-7]. A. Nalyvayko, O. Grebeshkova and

Y. Sytnyk [8-9] focus on the modern paradigm of knowledge management. O. Sobko considers the dominants of value creation through the prism of intellectual potential development [10].

Nevertheless, issues related to the industrial enterprises intellectual potential management system development remain insufficiently studied, which necessitates their further study to ensure the effective use of this potential.

**The purpose of the article.** Deepening of theoretical and methodological bases, and development of methodical approach to development of intellectual potential management system, based on innovations hidden opportunities mobilization, for the purpose of fundamentally new competitive advantages reception by domestic industrial enterprises in the conditions of knowledge-based economy formation.

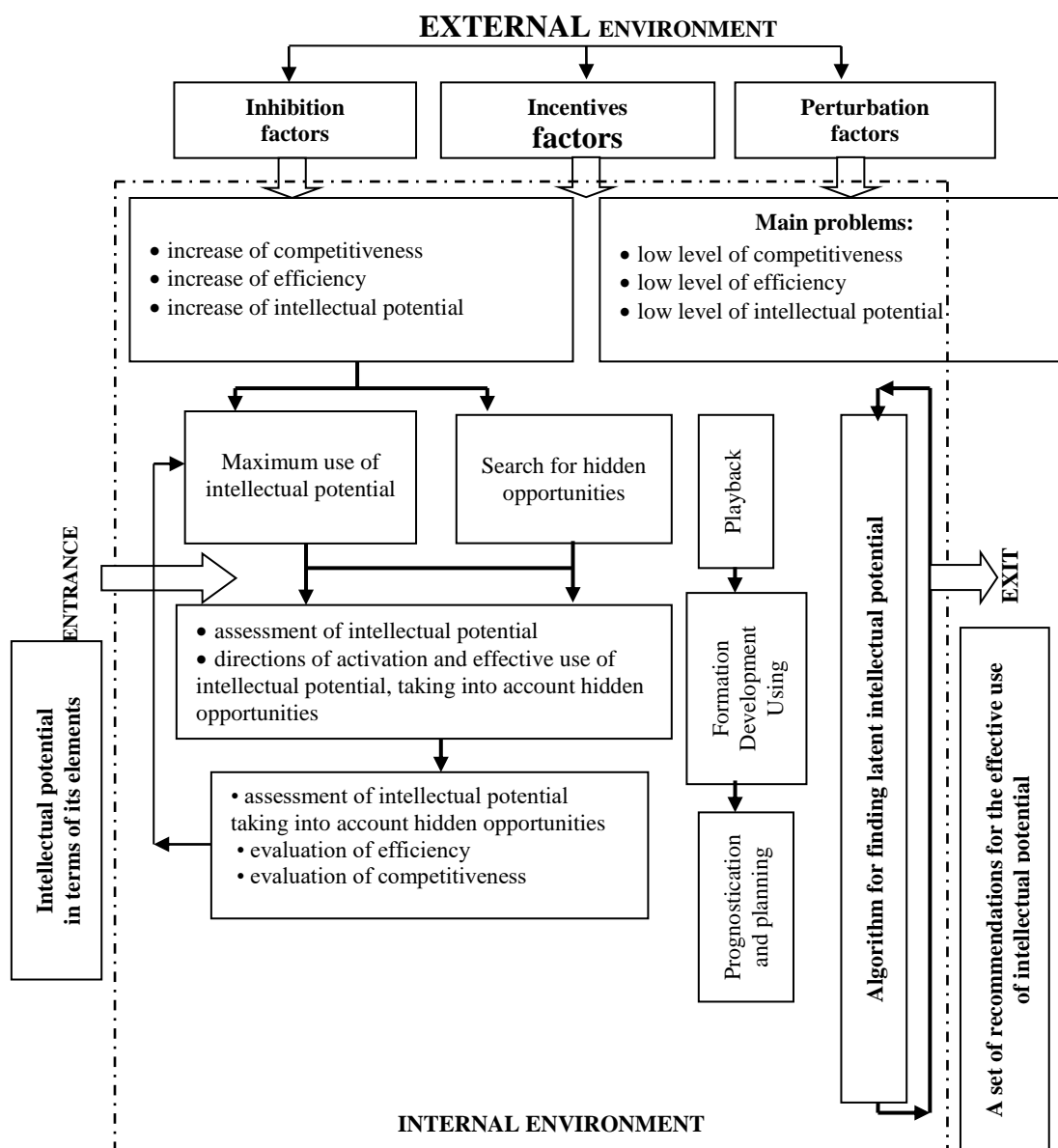
**Results and discussion.** Management of intellectual potential is characterized by quiet serious intellectual load, which is placed on the manufacturer. The task of industrial enterprise intellectual potential managing, given the complexity, should be solved on the basis of a systematic approach, taking into account the hidden intellectual opportunities. According to the author, the concept of "hidden opportunities for innovation" is interpreted as potential for further improvement and development, which is hidden in the uncertainty of innovation, is able to manifest itself over a period of time under the influence of scientific, technical and economic factors [11, p. 111]. According to foreign researchers, "Such hidden or latent innovation ranges from improved production processes within firms to new product flavors that lead to greater sales" [12-13].

The hidden opportunities of innovations are determined both by the internal environment of the enterprise and by the influence of external environmental factors, among which one of the essential ones is the consumer and his conscious and unconscious needs. For a stable position in the market, the enterprise must constantly search for ideas and opportunities, the implementation of which will increase the efficiency and competitiveness of the enterprise. In this case, the detection and implementation of hidden ideas should meet the needs of consumers and create new value [14, p. 87]. Thus, the main task of the enterprise intellectual potential managing, taking into account the hidden ideas and opportunities for innovation is related to the issues of their search, implementation and further development. So, the state of the enterprise intellectual potential can be characterized as a set of elements of intellectual potential and its hidden opportunities.

The essence of intellectual potential management efficiency improving is the implementation of its individual elements, a significant place among which hidden opportunities are. The effectiveness of this management largely depends on the effectiveness of enterprise management in general. In this context, the mechanism of the enterprise intellectual potential management is an integral part of the enterprise management overall process and is based on its managerial potential, which is focused on the constant increase of economic potential and innovative development of the enterprise. Thus, the development of intellectual potential is provided not only by the presence of its individual elements, but also by a management mechanism that includes the stages of search, implementation and capacity building.

The model of intellectual potential management is a certain set of actions and takes into account a significant number of different factors that can influence the effectiveness of managing innovation process and intellectual activity of the enterprise. Identifying and implementing the hidden opportunities of innovation is rather complicated and labour-consuming process, associated with the need to predict different scenarios of enterprise development. Therefore, there is a need for long-term development of intellectual potential management system, aimed at its overall increase through the realization of hidden opportunities for innovation. Thus, the management system is a single mechanism, which consists of a set of elements and processes aimed at addressing issues of increasing the level of the enterprise intellectual potential use.

Figure 1 presents an approach to the of intellectual potential management system formation, taking into account the hidden intellectual opportunities, the main purpose of which is to develop a set of recommendations aimed at the effective use of intellectual potential of the enterprise.



**Fig. 1. Adaptive and rational approach to the development of intellectual potential management system**

*Source:* developed by the author.

The basis of the proposed algorithm is the interaction of two blocks. The first block involves the use of existing elements of innovation potential (human potential, structural potential, market potential). The second block includes the search for hidden opportunities, followed by an assessment of their impact upon competitiveness. Interacting, these blocks form the adaptability of the business entity to market conditions. The basis of adaptability is the process of finding hidden ideas and opportunities, the implementation of which provides new competitive advantages of the enterprise. An important role in the process of assessing the competitiveness of the enterprise is played by the method of assessing the intellectual potential of the enterprise, taking into account the hidden opportunities, which allows to determine its strengths and weaknesses, directions of development and so on.

Thus, the organizational mechanism for managing the intellectual potential of the enterprise is a system of organizational and economic measures, aimed at the effective use of intellectual potential, the identification and implementation of hidden opportunities for innovation.

The development of the system of intellectual potential management taking into account the hidden opportunities is the formation of certain ideas about the future state of the intellectual potential of the industrial enterprise taking into account the implementation of new innovations. According to

the general algorithm of the system approach, intellectual potential management system is transformed step by step.

1. Defining the purpose and objectives of management. The strategic goal can be formulated as the expected state of the system of intellectual potential. Thus, it is necessary to solve a number of tasks, in particular, to identify opportunities for growth of the existing intellectual potential of the enterprise and to identify hidden intellectual capabilities inherent in innovation in terms of:

1) retrospective analysis of intellectual potential development and use, where the emphasis is on the study of the development of intellectual potential formed elements and their detailing;

2) assessment of the enterprise intellectual potential of current level;

3) determination of the most favorable directions of industrial enterprise intellectual potential development where the vector of innovative activity direction connected with search of its hidden opportunities is set.

2. Analysis and evaluation of alternatives to achieve the goal will be considered through the prism of the following aspects:

1) analysis of the possibilities of using the existing intellectual potential. At this stage, it is necessary to predict possible future situations in which certain elements of intellectual potential may be due to the implementation of any activity;

2) identification of areas for identifying hidden intellectual opportunities, which will allow to develop options to improve the efficiency of the enterprise intellectual potential without significant costs;

3) producing ways to achieve goals and objectives. The formation of an intellectual potential management system is a process of conduct rules developing for the system, which are formed at the system-wide level.

As a rule, the quantity and quality of alternative ideas increase when the initial generation of ideas is separated from the evaluation of the final idea.

3. Evaluation and selection of the enterprise intellectual potential management system implementation. This stage is basic for making decision to improve the intellectual potential management. The result of the evaluation is the choice of a competitive option for further work on its implementation. Given the uncertainty and, as a consequence, the variety of options for achieving the goals, a necessary condition is to take into account the favorable and adverse consequences for the management system of intellectual potential of the enterprise. At the same time, on the basis of impact assessment, the analysis of the strengths and weaknesses of intellectual potential management existing system is carried out, taking into account its hidden opportunities. The decision to choose one or another competitive option is influenced by such factors as: legal protection; potential economic effect from the implementation of the option; costs that determine the result; latent innovations and their impact upon the external and internal environment of the enterprise. Evaluation and selection of a solution related to the management of the enterprise intellectual potential, it is advisable to carry out on the basis of a comprehensive approach, the application of which will take into account not only the possible economic effect of the solution, but also other complex effects (scientific, technological, social, informational, environmental, etc.). For this purpose, the following steps must be taken:

1) formation of revealed ideas evaluation criteria for a choice of the most effective decision variant. The task of this stage is to facilitate the selection of the best solution through a set of criteria that could comprehensively cover all stages of the intellectual potential management process. To solve this problem, it is advisable to use qualitative analysis, which will assess the advantages and disadvantages of the proposed solutions, reduce the degree of uncertainty and select the most effective solution using a list of criteria. In this case, the ranking of criteria by the degree of influence on the results can be done by the method of expert analysis.

2) ranking of the identified alternatives versions according to the assessment for the preparation of the decision. Ranking is a process of ideas organizing, carried out by experts at the stage of finding a solution, taking into account certain criteria: novelty; implementation period; quality; the scale of the impact on the activities of the enterprise; the possibility of development in production; conditions of implementation; the value of inflation; risk and uncertainty. The choice of the of the idea realization

variant can be caused by the following factors: availability of necessary resources for realization of the idea; management support; new perspective opportunities that open up in the implementation of a particular idea. For ranking, it is advisable to use the method of direct ranking.

3) the choice of an effective solution in the context of improving of the intellectual potential management system efficiency. When it comes to making decisions related to the management of intellectual potential, the most perspective is the use of systematic modeling methods. The choice of an effective solution in the process of intellectual potential management is carried out in the conditions of the enterprise various structures constant interaction, each of which is the bearer of own ideas, knowledge, experience. This aspect significantly affects the management process and, as a consequence, may manifest itself in an incomplete understanding and description of future phenomena and processes.

Making a decision- aimed at the development and effective use of intellectual potential takes place in conditions of a high degree of uncertainty. To reduce uncertainty, we propose to choose a solution option comprehensively, taking into account iterative and adaptive methods, quantitative analysis and construction of a "solution matrix".

*Iterative method.* The choice of the decision on realization of this or that revealed idea acquires, as a rule, iterative disposition. This method is programmable and is a procedure of successive approximations. This makes it possible to achieve certain accuracy in the decision-making process for managing the intellectual potential of the enterprise, in which a significant role is played by the hidden opportunities of innovation. This approach makes it possible to identify and correct weaknesses at the each on each iteration, adjust performance criteria and factors. Also, the iterative approach makes it possible to identify factors that have not been identified, but manifested only at the implementation stage.

*Adaptive method* – another system of modeling methods based on predictive or model calculations of new innovations various parameters that can be implemented as a result of managing the intellectual potential of the enterprise. In this context, the main purpose of the adaptive approach is timely and effective response to unforeseen situations and changing conditions. To implement an adaptive approach in the process of managing intellectual potential in the enterprise requires: extensive use of information technology along with accumulated practical experience; intuition of decision makers; feedback, which ensures the adaptation of the enterprise to the changing environment. In essence, the adaptive method provides high performance in terms of changing the intellectual potential of the enterprise through the development of new algorithms and solutions.

*Quantitative analysis* involves analyzing indicators of proposed solutions and assessing each element of intellectual potential implementation potential economic efficiency.

*"Decision matrix"* is a methodology for decision-making in conditions of uncertainty, involves the construction of a matrix that includes options for developing alternatives to making decision and options for situations of intellectual potential elements development: human potential (personnel potential (pp), scientific and technical potential (stp)), market potential (mp), structural potential (sp) and latent opportunities (lc) (Table 1).

Table 1

**"Decision matrix" for managing the intellectual potential of the enterprise in conditions of uncertainty**

| Options for decision-making alternatives | Options of intellectual potential elements development situations |            |           |           |           |
|--|---|------------|-----------|-----------|-----------|
|  | <i>pp</i>   | <i>stp</i> | <i>mp</i> | <i>sp</i> | <i>lo</i> |
| $A_1$                                    | $Epp_1$   | $Estp_1$   | $Emp_1$   | $Esp_1$   | $Elo_1$   |
| $A_2$                                    | $Epp_2$   | $Estp_2$   | $Emp_2$   | $Esp_2$   | $Elo_2$   |
| $A_3$                                    | $Epp_3$   | $Estp_3$   | $Emp_3$   | $Esp_3$   | $Elo_3$   |
| ...                                      | ...   | ...        | ...       | ...       | ...       |
| $A_n$                                    | $Epp_n$   | $Estp_n$   | $Emp_n$   | $Esp_n$   | $Elo_n$   |

Source: developed by the authors.

where  $A_1, A_2, A_3, A_n$  – options for decision-making alternatives;

$Epp_1, Epp_2, Epp_3, Epp_n$  – the effectiveness of the decision associated with changes in personnel potential;

$Estp_1, Estp_2, Estp_3, Estp_n$  – the effectiveness of the solution associated with the change of scientific and technical potential;

$Emp_1, Emp_2, Emp_3, Emp_n$  – the effectiveness of the solution associated with changes in market potential;

$Esp_1, Esp_2, Esp_3, Esp_n$  – the effectiveness of the solution associated with changes in structural capacity;

$Elo_1, Elo_2, Elo_3, Elo_n$  – the effectiveness of the solution associated with the identification and implementation of latent opportunities.

For each combination of decision-making alternatives and situations of intellectual potential elements development, a general indicator of decision effectiveness can be determined  $E(A_n)$ :

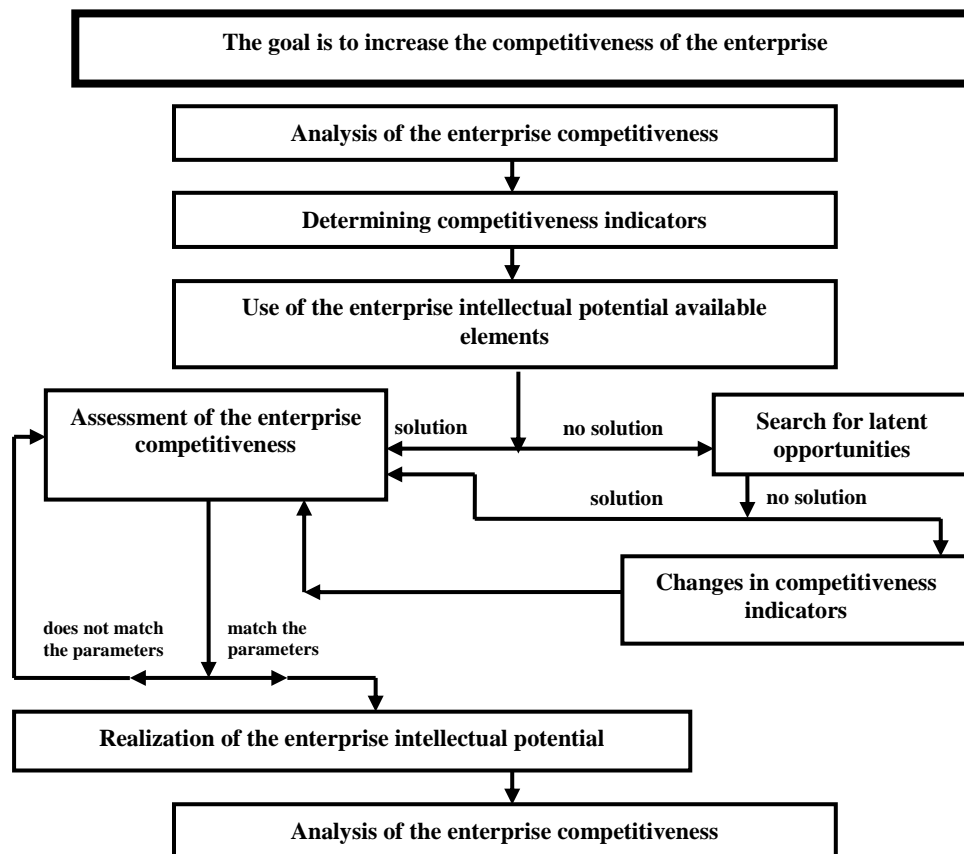
$$E(A_n) = \sqrt[5]{Epp_n} \times Estp_n \times Emp_n \times Esp_n \times Elo_n. \quad (1)$$

On the basis of the given matrix it is possible to calculate the best of alternative decisions on the chosen criterion. The calculation method depends on the conditions of risk and uncertainty.

Decision-making in conditions of risk is based on the fact that for each variant of the situation of development of intellectual potential elements a certain probability of its realization can be set. This will make it possible to weigh each of the specific efficiency values for the individual alternatives to the probability value and, as a result, to obtain an integrated indicator of risk level that will correspond to each decision-making alternative. Comparing integrated indicators for all decision-making alternatives allows choose the solution that will ensure the minimum level of risk. Estimation of probability of enterprise intellectual potential separate elements realization can be received by a method of expert estimations. Decision-making in conditions of uncertainty is based on the fact that each of intellectual potential elements development probabilities variant is unknown. In these circumstances, the choice of alternative solutions is made taking into account the risk and the relevant criteria for choosing from all alternatives. To make decisions in conditions of uncertainty, we propose to use the following basic criteria. Wald's criterion assumes that of all the possible alternatives, the best will be the one that will provide the best result in the worst case scenario. That is why Wald's criterion is also called the criterion of guaranteed result. Savage's criterion is based on the fact that in the case, when the solutions are aimed at maximizing the indicators, there is a "maximum", i.e. the maximum value of the minimum. The best alternative would be the one with the least lost benefit. The criterion of "maximax", according to which, the optimal solution will be the alternative that can provide the greatest efficiency. The Laplace's criterion is based on the fact that the probability of all potential elements realization is equally probable. The optimal solution will be the maximum arithmetic average. This criterion may be optimal when choosing an alternative solution in conditions of uncertainty, but it does not take into account the possible strong scatter among the possible results. The Hurwitz test allows us to be guided by the average efficiency result, which is between the extremes of each alternative solution. To do this, the so-called "optimism coefficient" is introduced. Note that ignoring intermediate options between extreme values can lead to erroneous decisions. A combination of criteria should be used to select the most optimal solution. This approach will allow a comprehensive study of alternative solutions and reduce the problem of uncertainty.

In order to increase of an industrial enterprise competitiveness efficiency, we propose to use an algorithm that takes into account the search for the studied category (Fig. 2).

The formation of competitive advantages of industrial enterprises on the basis of the enterprise intellectual potential effective use is a complex management process. One of the components of this process is the methodology of finding the latency of innovations using methods of marketing, forecasting and solving creative problems [11, p. 104-110]. In this context, it is important to point out the following aspects: the enterprise competitiveness increasing process through the use of intellectual potential should be cyclical; the search for the latency of innovations must be carried out even in the case of intellectual potential available elements sufficiency. In this case, the detection and implementation of hidden ideas should meet the needs of consumers and create new value [14, p. 87].



**Fig. 2. Algorithm for increasing the enterprises competitiveness based on the effective use of intellectual potential, taking into account the hidden innovation opportunities**

Source: developed by the author.

**Conclusions.** Increasing the efficiency of the enterprise intellectual potential management can be achieved as a result of continuous search for hidden ideas at all stages of innovation life cycle and at all stages of the enterprise. The paradigm of taking into account the latency of innovations proposed in the research promotes the development of industrial enterprises intellectual potential management system, which is of main importance for increasing the competitiveness of domestic industrial enterprises. The criterion for the implementation of innovation hidden potential is usually the economic effect of hidden idea implementation.

Conclusions and recommendations of the study are the basis for further scientific, theoretical and applied developments in the context of building an organizational and economic mechanism to ensure effective use of the intellectual potential of domestic industrial enterprises in the formation of a knowledge-based economy.

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**ОСТРОВСЬКА Галина Йосипівна**  
кандидат економічних наук, доцент,  
Тернопільський національний технічний  
університет імені Івана Пулюя,  
м. Тернопіль, Україна

## **МОДЕЛЮВАННЯ СИСТЕМИ УПРАВЛІННЯ ІНТЕЛЕКТУАЛЬНИМ ПОТЕНЦІАЛОМ ПРОМИСЛОВОГО ПІДПРИЄМСТВА**

**Проблема.** В сучасних умовах проблема ефективного використання інтелектуального потенціалу промислових підприємств набуває все більшого практичного значення. Від оперативного вирішення цього завдання залежить подальший інноваційний розвиток підприємств, а також економічна і технологічна безпека держави. Фахівці одноставні в тому, що незначна кількість вітчизняних промислових підприємств володіють потужним інтелектуальним потенціалом, оскільки не здатні ефективно ним управляти, що негативно впливає на ефективність їх інтелектуально-інноваційної діяльності. При цьому існуюча система управління інтелектуальним потенціалом характеризується орієнтацією на усунення слабких місць за рахунок наявних ресурсів підприємства. Вона практично не передбачає мобілізації додаткових можливостей цього потенціалу, прихованих в нових техніко-технологічних і організаційних рішеннях. Реалізація прихованих у нововведених ідей та можливостей, що є джерелом нової цінності та має статус одного з головних чинників оперативної та стратегічної конкурентоспроможності, здатна забезпечити нові перспективи інноваційного розвитку підприємств.

**Мета.** Поглиблення теоретико-методологічного підґрунтя та розроблення методичного підходу щодо розвитку системи управління інтелектуальним потенціалом на основі мобілізації прихованих можливостей нововведень з метою отримання вітчизняними промисловими підприємствами принципово нових конкурентних переваг в умовах становлення економіки, заснованої на знаннях.

**Результати.** Стаття присвячена питанням розвитку системи управління інтелектуальним потенціалом з урахуванням його прихованих можливостей з метою підвищення конкурентності вітчизняних промислових підприємств в умовах становлення економіки, заснованої на знаннях. Розкрито нове розуміння сутності категорій «приховані можливості нововведень», «система управління інтелектуальним потенціалом промислового підприємства», «організаційний механізм управління інтелектуальним потенціалом промислового підприємства». Запропоновано адаптивно-раціональний підхід до розвитку системи управління інтелектуальним потенціалом. Виокремлено ключові етапи побудови системи управління інтелектуальним потенціалом. Охарактеризовано основні критерії для прийняття рішень в умовах невизначеності. Розроблено алгоритм підвищення конкурентоспроможності промислових підприємств на основі ефективного використання інтелектуального потенціалу за рахунок виявлення та реалізації прихованих можливостей нововведень. Вказано на цінності реалізації прихованого інтелектуального потенціалу, яка полягає саме в здатності подальшого поступального розвитку нововведення та реалізації величезних можливостей, які в ньому

закладені. Зазначено, що в результаті реалізації системи управління інтелектуальним потенціалом з урахуванням виявлення нових ідей, крім економічного ефекту можуть бути отримані такі види ефекту, як науковий, технологічний, соціальний, інформаційний, екологічний тощо. Доведено, що підвищення ефективності управління інтелектуальним потенціалом підприємства може бути досягнуто в результаті неперервного пошуку прихованих ідей на всіх етапах життєвого циклу нововведення і на всіх етапах діяльності підприємства. Для зростання інноваційної активності та підвищення конкурентоспроможності вітчизняних підприємств управління інтелектуальним потенціалом має здійснюватися систематично і спрямовуватися на постійний пошук прихованих можливостей нововведення.

**Наукова новизна.** Розвинуто методичні підходи в контексті управління інтелектуальним потенціалом промислових підприємств. Запропонована в дослідженні парадигма урахування латентності нововведень сприяє розвитку системи управління інтелектуальним потенціалом промислових підприємств, що має ключове значення для підвищення конкурентоспроможності вітчизняних промислових підприємств.

**Висновки.** Результати наукових досліджень підтверджують, що рівень інноваційної активності вітчизняних підприємств в останні кілька років неухильно знижується. Причина полягає не тільки в тому, що законодавча база не відповідає цілям інноваційної діяльності, але й унаслідок недостатнього вивчення питань, пов'язаних з формуванням системи управління інтелектуальним потенціалом підприємства. У цьому контексті для успішної інноваційної діяльності вітчизняних промислових підприємств необхідним є виявлення всіх чинників, здатних позитивно впливати на підвищення ефективності управління інтелектуальним потенціалом підприємства. Одним з таких чинників є приховані потенційно-здатнісні можливості нововведень. В умовах сьогодення виявлення ідей та можливостей реалізації нововведення повинно розглядатися керівництвом підприємств як одне з ключових завдань, вирішення якого зумовить підвищення їх конкурентоспроможності на перспективу. У цьому контексті система управління інтелектуальним потенціалом є комплексною системою, ефективність управління якої залежить від повної узгодженості дій усіх структур промислового підприємства, їх зацікавленості в постійному пошуку і впровадженні нових ідей, що знаходяться в прихованому стані. Рекомендації дослідження відкривають горизонти для подальших наукових розвідок у сфері побудови організаційно-економічного механізму забезпечення ефективного використання інтелектуального потенціалу в умовах промислових підприємств.

**Ключові слова:** інтелектуальний потенціал, система управління інтелектуальним потенціалом промислового підприємства, організаційний механізм управління інтелектуальним потенціалом промислового підприємства, приховані можливості нововведень.

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