

УПРАВЛІННЯ ПІДПРИЄМСТВОМ

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**MODELING OF FACTORS INFLUENCING
INNOVATION ACTIVITIES OF
AGRICULTURAL ENTERPRISES OF
UKRAINE**

**МОДЕЛЮВАННЯ ФАКТОРІВ ВПЛИВУ НА
ІННОВАЦІЙНУ ДІЯЛЬНІСТЬ ПІДПРИЄМСТВ
АПК УКРАЇНИ**

Urgency of the research. Modern processes of reforming AIC on the basis of the critical state of Ukraine's economy, much of which the agricultural sector, demands from AIC to improve their organizational and administrative activities based on implementation and good governance of innovation process (IP).

Target setting. Efficient solving of occurring issues in these rapidly changing conditions in the economic and socio-political environment requires the use of analytical techniques in the management of agricultural enterprises, IP-based instruments of economic and mathematical modeling, taking into consideration peculiarities of agricultural production.

Actual scientific researches and issues analysis. The main approaches to the design of the systems associated with managing IP, realized with descriptive tools or presented with insufficient formalization, and offer practically an experiment with managing IP, avoiding the possibility to assess the impact and consequences of various options for managing IP in the future prospect of minimizing risks in management IA while making management decisions.

Uninvestigated parts of general matters defining. The scientists haven't yet developed the tools of economic and mathematical modeling for the control and management of full technological cycle, necessary for innovation in production.

The research objective. The article studies the patterns of development and management of IP enterprises in Ukraine, as well as mechanisms of their internal and external relationships.

The statement of basic materials. The dynamics of ID agricultural enterprises in terms of its components has been analyzed, was researched its ID development tendencies based on the analysis of the dynamics of changes in key indicators of the domestic agricultural production. The factors influence the level ID agrarian enterprises and factor analysis was performed. With the results the system of latent factors models based on the calculated integral indicators of the components of their IA, including the dynamics of innovation in the enterprises, the dynamics of costs and IA funding sources, the dynamics of introducing IA.

Conclusions. Calculated latent factors of IA agricultural enterprises, it should be appropriate to use as guidelines for foreign trade in order to determine the IA strategy for Ukraine on the world agricultural market.

Keywords: innovation activity; innovation processes; agribusiness; agricultural products; modeling; latent factors.

Актуальність теми дослідження. Сучасні процеси реформування галузі АПК з урахуванням критичного стану економіки України, значна частка якої належить аграрному сектору, вимагає від підприємств АПК вдосконалення їхньої організаційної й управлінської діяльності на основі впровадження та раціонального управління інноваційними процесами (ІП).

Постановка проблеми. Ефективне вирішення виникаючих при цьому завдань в швидко змінюваних умовах економічного та соціально-політичного середовища потребує застосування аналітичних методів в управлінні ІП підприємств АПК на основі інструментарію економіко-математичного моделювання з урахуванням особливостей аграрного виробництва.

Аналіз останніх досліджень і публікацій. Основні підходи щодо моделювання систем, пов'язаних з управлінням ІП, здійснено описовими засобами або представлено з недостатньою формалізацією, і пропонують практично експериментувати з управлінням ІП, уникаючи можливість оцінити результативність та наслідки різних варіантів управління ІП в майбутній перспективі з мінімізацією ризиків ІД при прийнятті управлінських рішень.

Виділення недосліджених частин загальної проблеми. Науковцями ще недостатньо розроблено інструменти економіко-математичного моделювання для контролю та управління повним технологічним циклом, необхідним для впровадження інновацій у виробництво.

Постановка завдання. Стаття присвячена дослідженню закономірностей розвитку та управління ІП підприємств АПК України, а також механізмів їх внутрішніх та зовнішніх взаємозв'язків.

Виклад основного матеріалу. Досліджено динаміку рівня ІД підприємств АПК в розрізі її складових, виявлено тенденції її розвитку ІД на основі проведеного аналізу динаміки змін основних показників вітчизняного агровиробництва. Визначено фактори впливу на рівень ІД агропідприємств та виконано факторний аналіз. За допомогою його результатів розроблено систему моделей латентних факторів на основі обчислених інтегральних показників, що характеризують складові їх ІД, зокрема, динаміку інноваційної активності підприємств, динаміку витрат та джерела фінансування ІД, динаміку впровадження ІД.

Висновки. Обчислені латентні фактори ІД підприємств АПК доцільно використовувати у зовнішньоекономічній діяльності у якості рекомендацій для визначення стратегії ІД Україні на світовому ринку сільськогосподарської продукції.

Ключові слова: інноваційна діяльність; інноваційні процеси; підприємства АПК; сільськогосподарська продукція; моделювання; латентні фактори.

УПРАВЛІННЯ ПІДПРИЄМСТВОМ

Urgency of the research. The current state of Ukraine's economy, much of which belongs to the agricultural sector depends on accurate assessment, forecasting, planning and effective management of the enterprises of AIC. Implementation of state acts and the condition, including sustainable development strategy "Ukraine-2020", which includes a Program of innovation development, demands from AIC to improve their organizational and administrative activities based on implementation and good governance of innovation process (IP). This is especially regarded agrarian enterprises as the sector of agricultural production involves significant share of total AIC.

The most urgent this task got after the ratification of the Association Agreement between Ukraine and the EU is providing free trade zone Ukraine - EU. Regulations, directives, decisions and recommendations of the EU contained in the addition to the Agreement, are part of the legal standards to be met by Ukrainian side, and they demand from agricultural enterprises to release innovative products with high quality consumer characteristics, the use of innovative technologies of deep processing of agricultural raw materials and storage and other elements of innovation activity (IA). The implementation of these demands in order to led domestic agricultural sector onto a higher level, including European standards, stabilization and development of agricultural production requires the development of ID in the field of agriculture, development of new approaches and mechanisms for its implementation. [1]

Effective solution for the task appearing in these rapidly changing conditions in the economic and socio-political environment requires the use of analytical techniques in management of innovation processes of enterprises (MIPE) based on instruments of economic and mathematical modeling considering agricultural production.

Target setting. At today stage it is necessary to implement comprehensive measures to support domestic business entities IA, including agricultural enterprises at all stages of IP, stimulating demand for the results of research and innovation, the availability of qualified personnel, creating favorable conditions for production of innovative products with high added value.

Actual scientific researches and issues analysis. Let's consider the basic approaches to modeling of socio-economic systems, particularly related to MIPE, studies of local scientists lately. The scientist N. K. Vasilyeva investigated questions of mathematical modeling of innovative development in agricultural economics [2]. In order to solve the proposed problem network integration patterns of dissemination of innovative technologies were used, products and management based on diversification and competition. The scientists used a model of formation and functioning of innovative systems of upgrade the agricultural clusters and developed appropriate model with methods of one-criterion optimization theory on the hypergraphs, by means of deterministic and probabilistic automats of Moore and simulation of automatic-probabilistic simulation and stochastic networks of Petri. But the solution of the task of MIPE set by the author requires the use of different mathematical tools as exogenous factors analysis confirmed the hypothesis of determinism model and unacceptable use in it of probability values. Besides, according to the author, it is preferable to use optimization models the integrated study of the effectiveness MIPE.

The scientist P. M. Hrytsiuk in his studies developed dynamic and stochastic methods for constructing mathematical models and models of the dynamics of the key indicators of grain, based on the theory of harmonic oscillations and statistical classification of difference series. The method of adaptive harmonic analysis of time series was proposed, using the tools of chaotic dynamics [3]. The studied models have considerable practical significance for the management of agricultural production, but for the use as for management of IA it requires modification, adaptation and other additional researches.

The scientist V. O. Dylenko used traditional methods and some of new approaches. Scientists considered static and dynamic optimization problem of IA system implemented by companies and is performing their quantitative analysis, the model "Input-Output" is used [4]. But these studies have not paid enough attention to managing the IP in terms of the relationship with the functions of primary production when it is introduced (including a portfolio of new products according to implemented IP), and as a result, the issue of dynamic optimization control parameters of IP relating to the characteristics of the production system resource capacity and other indicators of the company.

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For the quantitative assessment and strategy formation of investment activity on the example of industrial enterprises in the structurally innovative transformation of the national economy in her studies, the scholar O. M. Yastremska [5] applied methods of multivariate factor analysis to determine the explicit and latent factors affecting general trends and their changes, on which the author offered formation factors of influence the management of IP in the study of the problem MIPE.

In works [6; 7] there are a lot of methodological approaches, conceptual conditions and other methodological issues related to development of economic objects IA that are based mainly on organizational and managerial methods of improving the management of IA and the formation of a portfolio of innovative investment projects.

According to the review of foreign literature, special attention is given to the organizational and managerial forms of IA management in modern enterprises [8-10]. Mean while innovation management by modeling remains an open question for researchers. In addition, existing models may have limited usefulness and should be adapted to the specific conditions of agricultural enterprises [11].

According to foreign scholars who carry out innovation (Zott, Amit, Massa et others), innovative technologies and innovative ideas themselves have no economic meaning [12; 13]. Some scholars see a way out of the problem through the recommended results of developed economic and mathematical models that must mediate between technology and creating of new economic benefits [14].

An analysis of foreign literature on economic and mathematical modeling in the management of IP has shown that there are also difficulties associated with the dynamics of the model, parameters that change over the time, and due to the complicated nature of interdependencies between the components of the model (including delays and availability feedback). Awareness of the problems associated with the modeling of IP in practice, contributed to scientific developments and the wide application hybrid models through a combination of formal, informal text, graphics and special verbal approaches. These tools offer innovative simplified model and in many cases provide graphic interpretation. As a result, most models of IP management are carried out with descriptive means or are fragmented analytically presented with insufficient formalization, and are characterized by lack of practical orientation, comprehensiveness, complexity in application. They simplify the knowledge and offer the opportunity for virtual experiment with IP managing, avoiding the possibility to assess the impact and consequences of different options of IP management in the future perspective of minimizing risk in IA in management decisions because companies do not have the tools of economic and mathematical modeling for the control and management of full technological cycle necessary for innovation in production.

Uninvestigated parts of general matters defining. One of the main problems that occur in most of the tasks of managing the IP - is uncertainty, in particular, the presence of various risks influences negatively the modeling. It arises not only because of the inability to accurately predict future market conditions, dependence on time, but also because of computational difficulties connected to the development of the model. Even with the identification of future trends and developments, the uncertainty will not be completely eliminated, but will only decrease. Also there is a "calculative" complexity due to the large number of possible combinations between logical components of the model [15].

Resolving the methodological issues as modeling facilitates promotes for either development of effective strategies in the study of general properties and performance models or design methods and create solutions for specific tasks. The selection of methods for solving is determined according to the class to which the model is based on its classification. [16] Therefore, despite the significant number of publications, role and strategic positioning of Ukraine in the aspect of IA in global agricultural market is very important issue and needs further investigation.

The research objective. Research of the trends of the level of innovation agricultural enterprises and identifying their key components of the innovation development of Ukraine in the global agricultural market based on study of factors influence the level of innovation of agricultural enterprises and identification of latent factors that affect the performance of the dynamics of domestic agrarian enterprises.

The statement of basic materials. Based on statistical information [17] we analyze the dynamics of innovation implements by the agricultural enterprises in Ukraine (Fig. 1).

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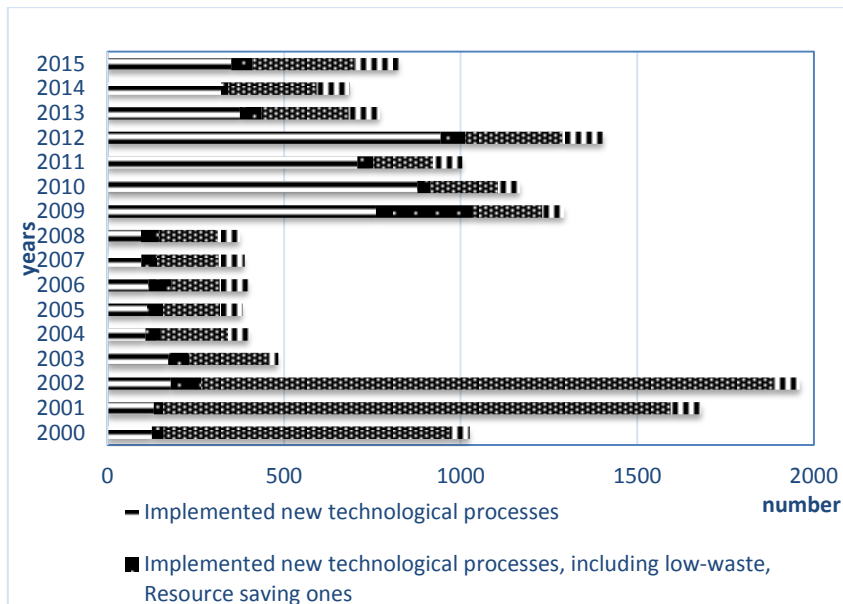


Fig. 1. The dynamics of innovation implement by agricultural enterprises in Ukraine(2000-2015)

According to the results of the analysis we may conclude that, unfortunately, the number of implemented domestic innovation in the AIC enterprises with general tendency to increase, in the last year has decreased.

The dynamics of expenses for innovation by the AIC enterprises in Ukraine is performed on (Fig. 2) [17].

Dynamics of investments by source of financing by the agricultural enterprises over the past fifteen years is performed on (Fig. 3) [17].

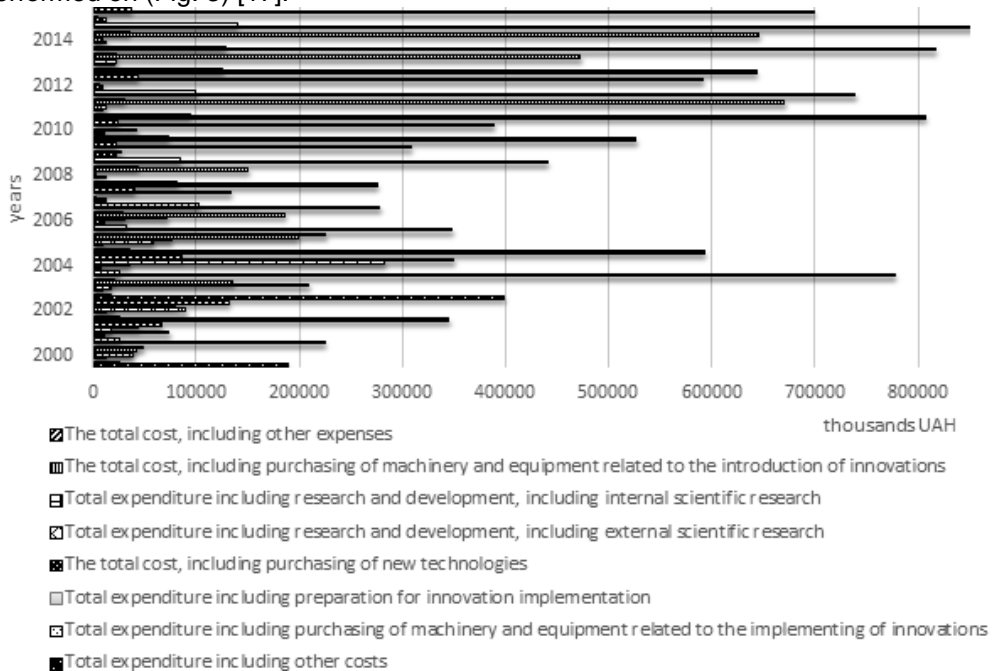


Fig. 2. The dynamics of innovation implement by agricultural enterprises in Ukraine (2000-2015)

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In order to investigate the factors of influencing the IA level of agricultural enterprises in terms of its components, the method of multivariate statistical analysis (factor analysis) was used. This analysis is intended for the detection and quantitative description of generalized characteristics that sufficiently describe the entire set of source and resulting performance, thereby reflecting MIPE laws and mechanism of their internal relationships. Calculations were performed on the example of agriculture of Ukraine using the statistical package Statgraphics Centurion.

In order to build a system model of latent factors that affect the components of the IA enterprise of Ukraine it is advisable to calculate the integral parameters characterizing components of IA enterprises, such as: 1) the dynamics of innovation in the enterprises, 2) the dynamics of costs and funding IA sources, 3) dynamic introduction of IA companies. Each component of the system is characterized by certain indicators.

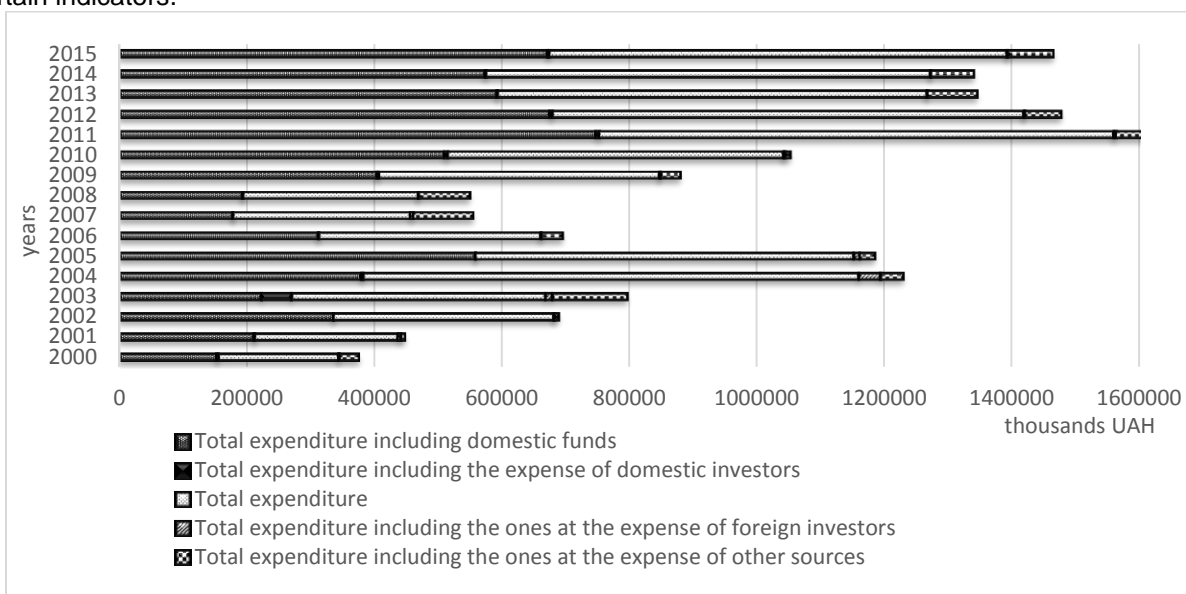


Fig. 3. Dynamics of investments by source of financing by the agricultural enterprises (2000-2015)

Thus, the dynamics of enterprises innovation activity describes the following indicators: x_1 – specific weight of enterprises dealing with innovation; x_2 – the total costs of enterprises dealing with innovation; x_3 – expenses on research and development; x_4 – total cost of internal scientific research; x_5 – costs for external scientific research; x_6 – expenses on new technologies; x_7 – expenses on preparing for production for innovation implementation; x_8 – expenses for machinery and equipment related to the introduction of innovations; x_9 – other costs for implementation of innovations.

The second component – is the dynamics of costs and funding sources IA enterprises, depends on the following parameters: x_{10} – the expense of domestic investors; x_{11} – the total expenses; x_{12} – expenses on the cost of domestic investors; x_{13} – expenses on the costs of foreign investors; x_{14} – expenses on the costs of other sources.

Assessment of the dynamics of implementing IA enterprise, which is the third component, is as follows: x_{15} – specific weight of enterprises that implemented innovations; x_{16} – the number of implemented new processes; x_{17} – the number of new low-waste, resource-saving processes; x_{18} – the number of items of mastered kinds of innovative products; x_{19} – the number of items of mastered kinds of innovative forms of technology; x_{20} – specific weight of sales of innovative products by industrial enterprise.

In the first component of the IA enterprise in Ukraine - the dynamics of innovation in the enterprises gets affected by several factors that we consider as three factors. They explain variability of parameters that define this component for 73.67%. Latent factors that influence the dynamics indexes of innovation activity of domestic enterprises are described by the following equations:

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$$\begin{aligned}
 F_{11} &= 0,705x_{11} + 0,217x_{12} - 0,023x_{13} + 0,094x_{14} + 0,152x_{15} + \\
 &\quad + 0,771x_{16} + 0,377x_{17} - 0,747x_{18} + 0,857x_{19} - 0,931x_{20}, \\
 F_{12} &= 0,549x_{11} - 0,634x_{12} - 0,195x_{13} - 0,201x_{14} + 0,766x_{15} + \\
 &\quad + 0,366x_{16} - 0,213x_{17} + 0,282x_{18} + 0,927x_{19} + 0,075x_{20}, \\
 F_{13} &= 0,077x_{11} + 0,029x_{12} + 0,918x_{13} + 0,909x_{14} - 0,026x_{15} - \\
 &\quad - 0,300x_{16} - 0,428x_{17} - 0,292x_{18} - 0,090x_{19} + 0,085x_{20}.
 \end{aligned}$$

Thus, the first factor is the most important for all the enterprises, formed with the indexes towards reducing the factor loadings: $x_{20}, x_{19}, x_{16}, x_{18}, x_{11}$, other indicators may be neglected because their load factor is less than 0,5. The second – by the indexes: $x_{19}, x_{15}, x_{12}, x_{11}$. The third factor of the state of IA enterprise in Kharkiv region is characterized by the following sequence of indexes: x_{13}, x_{14} . Thus, having analyzed, first three latent factors affecting the dynamics of innovation in the enterprises occurred, they are – x_{20}, x_{19}, x_{13}

In the second part of the IA enterprises - the dynamics of costs and funding sources IA get affected by several factors, which also will be considered three latent factors with equations such as:

$$\begin{aligned}
 F_{21} &= 0,902x_1 + 0,203x_2 + 0,925x_{15} + 0,382x_{16} - 0,112x_{17} + 0,536x_{18} + 0,787x_{19}, \\
 F_{22} &= -0,311x_1 + 0,864x_2 + 0,125x_{15} + 0,611x_{16} - 0,018x_{17} - 0,778x_{18} + 0,308x_{19}, \\
 F_{23} &= -0,151x_1 - 0,024x_2 + 0,135x_{15} + 0,558x_{16} + 0,959x_{17} - 0,060x_{18} - 0,049x_{19}.
 \end{aligned}$$

Indexes rating by these factors, according to everyone are: x_{15}, x_2, x_{17} . The second group of three factors explains for 85.49% the variability of indexes, determining this component.

The third component of IA enterprises level in Ukraine – dynamics of implementation ID gets affected by three factors as well, which explains for 81.84%. The variability of indexes determined these components. The equation of these latent factors:

$$\begin{aligned}
 F_{31} &= 0,944x_1 + 0,042x_2 + 0,109x_3 + 0,887x_{15} + \\
 &\quad + 0,261x_{16} - 0,112x_{17} + 0,668x_{18} + 0,719x_{19}, \\
 F_{32} &= -0,179x_1 + 0,796x_2 + 0,781x_3 + 0,309x_{15} + \\
 &\quad + 0,689x_{16} + 0,042x_{17} - 0,690x_{18} + 0,484x_{19}, \\
 F_{33} &= -0,138x_1 - 0,128x_2 + 0,234x_3 + 0,113x_{15} + \\
 &\quad + 0,485x_{16} + 0,955x_{17} + 0,002x_{18} - 0,077x_{19}.
 \end{aligned}$$

So we have the seventh, eighth and ninth latent factors affecting the dynamics of IA enterprise implementation, indexes ratings which have the following sequence: x_1, x_2, x_{17}

Conclusions. In order to display the IA of AIC in Ukraine and mechanisms of their internal and external relationships, the factors of influencing the level IA in terms of its components and factor analysis was researched. Using the results developed system model of latent factors affecting the IA components, on the basis of calculated integrated indicators of the components of their IA, including the dynamics of innovation in the enterprises, the dynamics of costs and IA funding sources, dynamics of IA enterprises implementation. Latent factors determined by three components IA farms should be used in foreign trade as guidelines for determining the IA strategy for Ukraine on the world agricultural market.

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