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MODELLING THE FINANCIAL MANAGEMENT STRATEGY OF AN INNOVATIVE ENVIRONMENTAL ENTERPRISE

Abstract. *The modern conditions of the functioning of entrepreneurship are characterized by a high level of uncertainty, in particular, significant fluctuations in the market situation, intensifying competition, and actualization of security aspects of functioning. In addition, a significant anthropogenic impact on the environment and its destructive consequences increase public demand in the greening of economic activity. Therefore, the enterprise's innovative activity is a response to modern challenges. However, in the context of entrepreneurship, innovative activity is associated with additional risks. Such an aggressive functional environment requires enterprises to ensure a high level of management efficiency, so the role of financial management is growing. It is thanks to the effective management of financial flows that the innovative enterprise manages to achieve the minimization of financial risks and maximization of profit. The study was carried out based on financial reporting, which characterizes the entrepreneurial activity of an innovative enterprise. The analysis of the obtained data made it possible to assess the effectiveness of the financial flow management system of the innovative enterprise and to determine reserves for improving the efficiency of financial management. In the research process, statistical and comparative analysis methods were used, statistical modeling and abstraction.*

The assessment of the effectiveness of financial management is a critically important element of the management system, which allows for identifying and eliminating management deficiencies.

As a result of the study, a methodology was developed to assess the effectiveness of financial management of an innovative ecological enterprise.

The implementation of innovative activities, such as the greening of economic activity, requires an enterprise to ensure effective management of the enterprise's resources, in particular, the financial resources. The development and implementation of a highly effective mechanism for managing financial processes, which allows the realization of enterprise goals, is the key to the survival of an enterprise in modern conditions. One of the tools for improving the enterprise management system of financial conditions is the assessment of the effectiveness of financial management.

Keywords: *financial management, efficiency, innovative entrepreneurship, integrated assessment, ecology, reserves, system.*



1. Introduction

The functioning of national enterprises has always taken place under difficult conditions, but the last few years have been characterised by increasing turbulence in the functional environment and levels of uncertainty. The crisis caused first by the COVID-19 pandemic and later by the military aggression of the Russian Federation against Ukraine has brought many national enterprises to the brink of survival. In particular, innovative environmental enterprises are being forced to make excessive efforts to achieve a certain level of operational efficiency that will enable enterprises to survive in an unprecedentedly difficult environment. A significant role in solving this problem is played by the effective management of the innovative enterprise's resources, namely the effective management of financial resources. The purpose of financial management is to level out financial risks and their consequences and to maximise profits. The key elements of the financial management system are the management of the profitability and profitability of the innovative eco-enterprise and the evaluation of the effectiveness of financial resource management.

The analysis of financial management effectiveness is a complex task that requires the construction of a comprehensive evaluation system to provide information in a convenient form on the available reserves for improving management effectiveness.

Financial management is a set of principles and mechanisms for managerial decision-making on the formation, implementation and development of the financial potential of an enterprise, i.e. it involves a wide range of functions, in particular in the implementation of innovation activities and the greening of production.

Enterprise innovative activity is the key to economic growth and the integration of national

enterprises into the global economic system. The implementation of innovative activities is carried out by generating innovative technologies, products or management methods that increase the competitiveness and efficiency of the enterprise.

Many academic studies focus on the financial management problems of entrepreneurship, in particular innovation. For example, a search on Lens.org (“financial management” OR “finance management” OR management of finance”) AND (innovations OR innovation OR innovative OR modernization)” has yielded 15,222 research papers from a total of 252.1 million research papers. Accordingly, to the bibliometric analysis, publications on financial management date back to the early 1970s, but a rapid increase in the number of publications on the topic occurred in the early 2000s. The highest number of publications was registered in 2020. A visualisation of a scientometric map reflecting the intensity of the usage of one keyword with others — was constructed using the VOSviewer application. The resulting map is shown in Figure 1.

The map visualises four thematic clusters, comprising objects and the links between them. The size of the object characterises the strength of the overall relationship of the terms and the width of the lines characterises the strength of the relationship between the two terms. The formation of clusters takes place on the basis of the detected keywords. However, the division into clusters is quite conditional, because the clusters are quite strongly related to each other.

A considerable amount of academic work is devoted to the study of the general principles of financial management.

The various aspects, implementation problems, contradictions and benefits of financial management

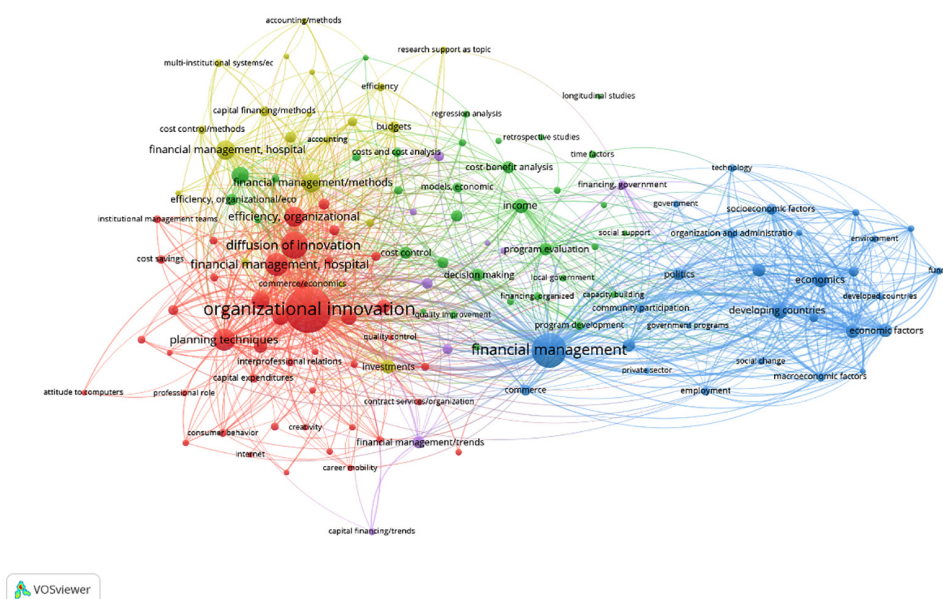


Figure 1. Scientometric map of the subject area “financial management”

Source: Developed by the author based on <https://www.lens.org/> using VOSviewer

have been investigated by many scholars around the world, notably Peel and Wilson, [1], Zopounidis, [2], Brounen *et al.*, [3], Brinckmann *et al.*, [4], Kioko *et al.*, [5], Abanis *et al.*, [6], Karadag, [7], and many others. In recent years, there has been an increase in the number of academic papers investigating the implementation of information technology into enterprise financial management practices. For example, Hao, [8], examines the development of an enterprise financial management platform using cloud technology and artificial intelligence. The implementation of innovative technology can improve information management and the quality of enterprise financial management. The author recommends a specific neural network and a bayesian regularisation algorithm for an application, and his work evaluates and analyses asset management in enterprise financial management process. Gao, [9], also notes in his paper the critical role of cloud technology in financial management practices. This is particularly important for small and medium-sized enterprises to reduce operational costs and achieve greater efficiency in financial management. Yang *et al.*, [10], Ren, [11], explore the optimization of enterprise financial management through the implementation of big data in financial management decision-making. Ren, based on information asymmetry theory and risk management theory, explores the role of big data in enterprise financial management. He analyses the impact of big data on the quality of forecasting, the relevance and speed of financial decision-making and the creation of competitive advantages. Ren concludes that the application of big data tools can improve the quality of an enterprise's financial management.

Some scholars separately research the financial management of innovative enterprises, so Bai, [12], in his study looks at the development of financial sector tools that enable the financing of scientific and innovative enterprises. The author stresses that in order to improve the efficiency of financing for innovative enterprises, it is necessary to constantly analyse the available financial tools and to improve financial management and information support for financing at the enterprise level. In addition, according to the author, at the level of the financial sector, it is important to improve the quality of personnel, to establish cooperation between financial institutions and science institutions, and to develop new financial products oriented towards the innovation sector.

Pan, [13], analyses the impact of the financial system on the development of scientific and technical innovation using China as an example. According to the author, the financial system and its efficiency are closely related to scientific and technological development. According to the degree of development of the financial system, the pattern of innovation development can change from a bouncing to a stable pattern.

The specifics of financing an individual innovation industry are considered in their research paper by Zhao *et al.*, [14]. The authors make a factor

analysis of the efficiency of enterprise research and development investments using the example of enterprises developing smart home products. Zhao, Meng, and Cai analyse the impact of market, technical and political factors. At the enterprise level, the authors note the impact of financial management on innovation performance. In particular, they emphasise the significant influence of the budgetary mechanism. The development of a new product requires adequate estimation of financial costs, determination of the necessary amount of investment in research and development, and a well-developed planning and management decision-making system. According to the authors, in the context of financial management, it is important to have an internal audit that can identify weaknesses in financial management and prevent the misuse of financial resources. The problems of green or ecological financial management are also the subject of academic research. For example, Dong, [15], researches the concept of green financial management in the context of greening mainstreaming. The author proposes measures to improve the effectiveness of the implementation of this concept, in particular, conducting advanced training for managers in the field of finance and sustainable development, optimisation of accounting in order to obtain a better information resource. Dong also draws attention to the problem of copyright enforcement in the context of new product development. For example, Liu, [16], analyses the importance of optimising the financial management system. In particular, after examining the readiness of enterprises to implement green financial management, the author proposes optimisation measures aimed at optimising financial management staffing.

Tao *et al.*, [17], identify in their scientific paper using a SWOT-analysis the challenges of implementing the concept of green financial management, namely the lack of government support to implement the concept, the lack of sufficient qualified managers and accounting shortcomings.

In the context of economic activity management, the management of a company's financial resources plays a critical role, which makes the issue of measuring the effectiveness of financial management relevant. Kuzmina-Merlino and Savina, [18], Świrski, [19], Raman *et al.*, [20], examine the problems of efficiency assessment in their works. The analysis of publications indicates that, despite the large number of scientific papers, some aspects of financial management remain insufficiently covered, in particular, the effectiveness of financial management of innovative environmental enterprise. The purpose of the study is to analyse the features of financial management of an innovative ecological entrepreneurship, as well as to develop a methodology for assessing the effectiveness of financial management of an innovative environmental enterprise.

A significant part of innovative projects is aimed at developing and introducing new technologies,

techniques, principles of production organisation and management solutions aimed at improving the efficiency of nature management, in particular by reducing the resource and energy intensity of production, and reducing the eco-destructive impact of production on the environment. After all, the ecologisation of the economy becomes a particularly urgent task in the context of the growth of negative anthropogenic and technogenic impacts on the environment.

Adequate financial resources support is a prerequisite for the introduction and effective implementation of enterprise innovation activity, particularly greening. It is important to note that the relevance of the problem of greening the national economy is increasing due to the requirements of the European integration process and the lack of public funds to finance ecological projects. Ecologisation of the economy is the key to sustainable development of the country, increased national competitiveness and harmonious use of natural resources. The state policy in the area of innovation and ecology defines the conditions for innovative activity and rational usage of resources by enterprises.

General trends in the development and realisation of national innovation potential are reflected in the global innovation index. Analysis of the dynamics of the index over the past five years indicates that there has been a deterioration in the innovation sphere in recent years (Figure 1).

Thus, between 2018 and 2021, Ukraine's ranking dropped by 6 points to 49th place, and in 2022 it dropped by a further 8 points to 57th place. Importantly, Ukraine scored higher in the innovation output group than in the innovation expenditure group. Ukraine's innovation performance is better than that

of its corresponding level of economic development. Ukraine's strongest points in terms of innovation performance are the development and diffusion rates of new knowledge and innovative technology and the productivity of creative activity. The worst indicators are mainly related to the level of market development, institutions and infrastructure, in particular credit and investment policy, and environmental sustainability. Environmental sustainability problems are to some extent the result of the high-energy intensity of the gross domestic product and low implementation level of ISO 14001 certificates.

Innovation and environmental activity of national enterprises are constrained by economic instability in the country. Economic instability reduces the ability of enterprises to make additional expenditures to finance innovation projects, particularly environmental ones. Shortcomings in credit and investment policy at the macro level affect the financial strategy of the innovative enterprise and the efficiency of financial management at the micro level. Financial support of innovation activity is one of the key tasks of the financial management of the enterprise. The sources of financing innovative activity may include the following: own funds of enterprises formed from depreciation charges and profits; public funds accumulated from budgetary or extra-budgetary funds; investment funds; credit resources provided by lending institutions.

Analysis of statistical data on the financing of innovative activities of industrial enterprises during 2016–2020 indicates a significant decrease in financing in 2017 as a whole, but the structure of financing sources saw an increase in financing from budgetary funds and non-resident funds. In 2018–2019, there has been an increase in funding from all

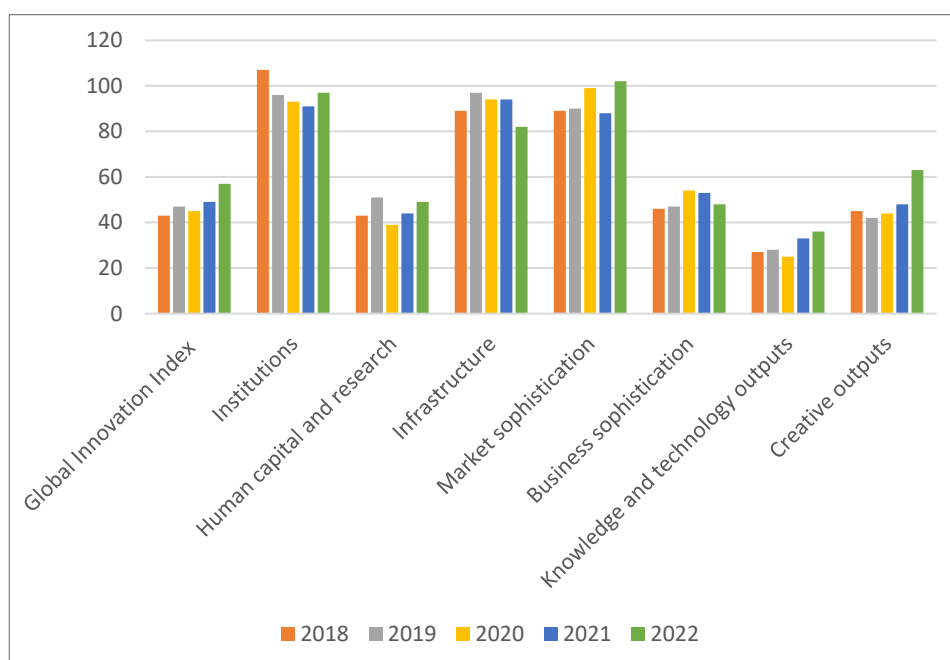


Figure 2. Dynamics of the Global innovation index for Ukraine 2018–2022.

Source: Built by the author research based on data from https://www.wipo.int/directory/en/details.jsp?country_code=UA

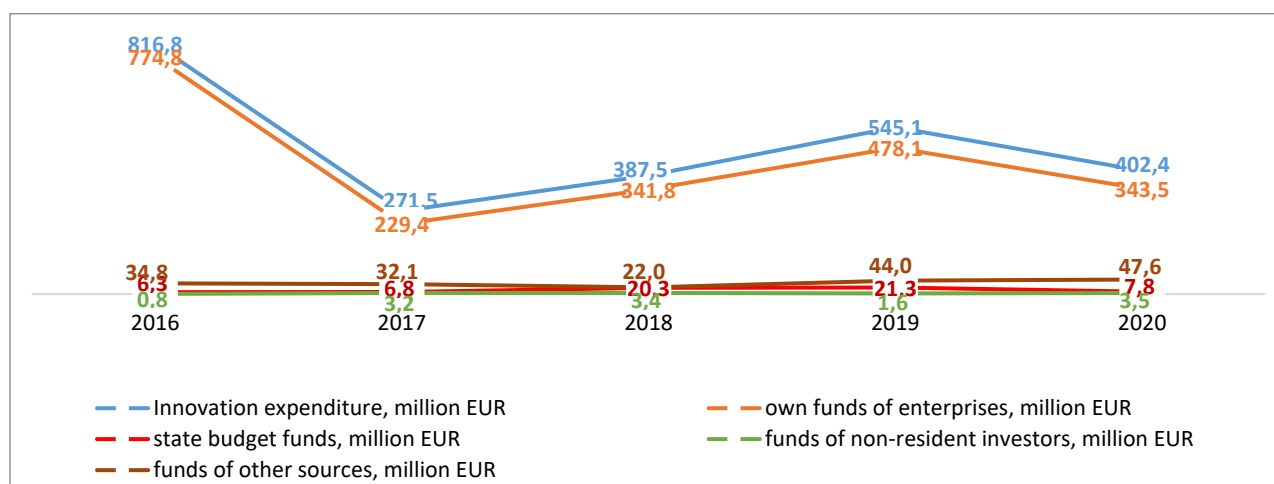


Figure 3. Financing sources of innovation activities of industrial enterprises

Source: Built by the author based on data from https://ukrstat.gov.ua/operativ/menu/menu_u/ni.htm

sources except funding from other sources in 2018 and from non-residents in 2019. In 2020, however, there was a decrease in funding for innovation, in particular, due to the COVID-19 pandemic crisis. The increase in funding came only from non-residents and unstructured sources.

Moreover, military aggression on the part of the Russian Federation has resulted in a difficult situation for innovation activity. On the one hand, the financial resources that can be used to finance innovative projects, in particular environmental projects, the risks associated with martial law have increased, and uncertainty has increased. On the other hand, the need to find, develop and implement new solutions to enable national enterprises to adapt to modern conditions, to level out the negative effects of war, and to ensure the survival of the enterprise in such difficult conditions has increased.

Based on the above, the factors that influence the financial management system of an innovative enterprise include: the availability of funding sources; the maturity of the banking system; the degree of enterprise integration into the global economy; the development of venture capital financing; the level of private ownership; the level of motivation for innovation activities.

Under current conditions, the financial management system of an innovative enterprise addresses the following problems: lack of funding sources; in particular the reduction of public funding; low access to long-term credit resources due to imbalances in the banking system; low access to venture capital; low level of innovation infrastructure development due to lack of financial resources; low level of private property institution development, in particular the unprotected rights of intellectual property. The effectiveness of the financial management of an innovative enterprise depends on the degree to which the enterprise's innovative activity, in particular its green manufacturing projects, are provided with financial resources. Assessing the effectiveness of

a company's financial management allows the identification of systemic weaknesses and possible ways to eliminate them. An effective evaluation generates an information resource that allows for more adequate management decision-making in conditions of high uncertainty.

2. Materials and Methods

The study was carried out based on the universal financial statements of an innovative environmental enterprise. The financial management of the enterprise is based on the fact that the economic and financial processes occurring in the enterprise form a single complex system. With this approach, management's influence on the financial and economic processes of the enterprise forms some specific qualities of this system and allows achieving more effective implementation of the financial management functions of the enterprise due to the resulting synergistic effect. Therefore, in the context of assessing the results of financial management functioning, it is important to develop such an assessment methodology that will take into account the impact of emergent qualities of the system.

Therefore, in order to study the level of financial management efficiency of an innovative ecological company, it is advisable to use a methodology involving the usage of dynamic normative in a systematic analysis of structural configurations. A similar technique was used by Lazko, who continued the Syroezhyn scientific school of system analysis. The essence of the method consists in modelling a normative system of ordered indicators reflecting the effectiveness of financial resources management and carrying out a comparative analysis of actual values [21]. Analysis of the dynamics of changes makes it possible to assess the effectiveness of implementation of the financial strategy over time. The general algorithm for this methodology involves the following steps:

1. Formation of a set of indicators that comprehensively characterise the business activity of an

enterprise, in particular, innovation and environmental activity;

2. Design a target matrix reflecting the normative values of the selected indicators according to the chosen strategy.

3. Formation of a current results matrix, which is compiled based on the actual values of the selected indicators;

4. Conducting a comparative analysis and generating a correspondence matrix and a discrepancy matrix;

5. Calculation of the integral indicator characterising the efficiency of the financial management of an enterprise.

The first stage is the selection of financial indicators accumulated from accounting records. It is advisable to include in the model those indicators that reflect the goal of financial management of the innovative enterprise, e.g. increasing profitability, ensuring financial sustainability, etc. It is important to note that most financial indicators that reflect the objectives of financial management are represented by ratios, namely: profitability ratios, liquidity ratios, financial independence and sustainability ratios.

The second step involves the design of a target matrix incorporating the selected financial data. The selected ratios are represented in the target matrix by the ratios of the growth rate of the numerator and denominator of an individual financial ratio. After all, based on the fact that financial ratios are represented by fractions, the growth of the ratios occurs if the growth rate of the numerator exceeds the growth rate of the denominator. According to the set of indicators, the target matrix is formed in the following quadratic form (1):

$$A = \begin{bmatrix} \alpha_{11} & \cdots & \alpha_{1m} \\ \vdots & \vdots & \vdots \\ \alpha_{i1} & \alpha_{ij} & \alpha_{im} \\ \vdots & \vdots & \vdots \\ \alpha_{m1} & \cdots & \alpha_{mm} \end{bmatrix}, \quad (1)$$

where A — is the target financial matrix;

α_{ij} — normative value of the ratio between the growth rate of i indicator and the growth rate of j indicator, with $\alpha_{ij} \in [-1; 2]$;

m — the order of the matrix A , determined by the number of indicators selected for the model.

The definition of the element α_{ij} , is determined by the following system of conditions (2), which is shaped by the strategic objectives of the financial management of the enterprise:

$$\alpha_{ij} = \begin{cases} -1, & T(X_i) < T(X_j); \\ 1, & T(X_i) > T(X_j), \quad T(X_i) \cdot T(X_j)^{-1} - 1 \leq k_{ij}, \quad k_{ij} > 0; \\ 2, & T(X_i) > T(X_j), \quad T(X_i) \cdot T(X_j)^{-1} - 1 > k_{ij}, \quad k_{ij} > 0; \\ 0, & \text{collaration between } T(X_i) \text{ and } T(X_j) \text{ has not been} \\ & \text{established, or } X = 0; \end{cases} \quad (2)$$

where $T(X_i)$, $T(X_j)$ — growth rate of i indicator and j indicator;

k_{ij} — the target limit value, determined in accordance with the strategic financial objectives. If no value k_{ij} not set, the element α_{ij} is defined within the values of $[-1; 1]$.

So, if the growth rate of the i indicator $T(X_i)$ does not exceed the growth rate of j indicator $T(X_j)$, then $\alpha_{ij} = -1$ if the growth rate of i indicator $T(X_i)$ exceeds the growth rate of j indicator $T(X_j)$ by more than the threshold value k_{ij} , then $\alpha_{ij} = 2$; the growth rate of i indicator $T(X_i)$ exceeds the growth rate of j indicator $T(X_j)$ is less than or equal to the threshold k_{ij} value, or equal to it, then if the ratio between the growth rate of i and j indicators has not been established, then $\alpha_{ij} = 0$. Thus, the strategic objectives of the financial management of the enterprise are aggregated.

The following formula (3) should be used to determine the growth rate of the financial indicator:

$$T(X_i) = X_i^t \cdot (X_i^{t-1})^{-1}, \quad (3)$$

where X_i^t — is the value of the financial indicator in the current period,

X_i^{t-1} — value of the i financial indicator in the previous period.

The next step is to calculate the results matrix R (4):

$$R = \begin{bmatrix} \rho_{11} & \cdots & \rho_{1m} \\ \vdots & \vdots & \vdots \\ \rho_{i1} & \rho_{ij} & \rho_{im} \\ \vdots & \vdots & \vdots \\ \rho_{m1} & \cdots & \rho_{mm} \end{bmatrix}, \quad (4)$$

where R — the matrix of actual results,

ρ_{ij} — the actual value of the ratio between the growth rate of indicator i and the growth rate of j indicator, with $\rho_{ij} \in [-1; 2]$;

m — the order of the matrix R determined by the number of indicators being monitored. Calculation of the element ρ_{ij} is calculated according to the following diagram (5):

$$\rho_{ij} = \begin{cases} -1, & T(X_i) < T(X_j); \\ 0, & T(X_i) = T(X_j); \\ 1, & T(X_i) > T(X_j), \quad T(X_i) \cdot T(X_j)^{-1} - 1 \leq k_{ij}, \quad k_{ij} > 0; \\ 2, & T(X_i) > T(X_j), \quad T(X_i) \cdot T(X_j)^{-1} - 1 > k_{ij}, \quad k_{ij} > 0; \end{cases} \quad (5)$$

Thus, if the growth rate of the i indicator $T(X_i)$ does not exceed the growth rate of j indicator $T(X_j)$, then $\rho_{ij} = -1$ if the growth rate of i indicator $T(X_i)$ exceeds the growth rate of j indicator $T(X_j)$ by more than the threshold value k_{ij} , then $\rho_{ij} = 2$; the $\alpha_{ij} = 1$ growth rate of i indicator $T(X_i)$ exceeds the growth rate of j — key value $T(X_j)$ by an amount less than or equal to the threshold value k_{ij} , or equal to it, then $\rho_{ij} = 1$; if the value k_{ij} is not set, the element ρ_{ij} is determined within

the limits of values of $[-1;1]$; if the growth rate of i is equal to the growth rate of the j — indicator, then $\rho_{ij} = 0$. The next step involves the calculation of a correspondence matrix C , which reflects the result of checking the normative and actual ratios of the growth rates of the financial indicators for coincidence (6):

$$C = \begin{bmatrix} c_{11} & \cdots & c_{1m} \\ \vdots & \vdots & \vdots \\ c_{i1} & c_{ij} & c_{im} \\ \vdots & \vdots & \vdots \\ c_{m1} & \cdots & c_{mm} \end{bmatrix} \quad (6)$$

where C — the matrix of correspondence of the actual indicators with the normative ones;

c_{ij} — the coincidence of the actual and normative ratios between the growth rate of i indicator and the growth rate of j indicator, at the same time $c_{ij} \in [0;2]$.

Calculation of the C matrix elements is calculated using the following constraint system (7):

$$c_{ij} = \begin{cases} 2, & \alpha_{ij} > 1 & \rho_{ij} \geq 2; \\ 1, & \alpha_{ij} > 0 & \rho_{ij} \geq 1; \\ 1, & \alpha_{ij} = -1 & \rho_{ij} \leq 0; \\ 0, & \text{under other conditions;} \end{cases} \quad (7)$$

Next, it is useful to calculate a deviation matrix D , which includes the results of checking for discrepancies of the actual normative ratios of the growth rates of the financial indicators (8):

$$D = \begin{bmatrix} d_{11} & \cdots & d_{1m} \\ \vdots & \vdots & \vdots \\ d_{i1} & d_{ij} & d_{im} \\ \vdots & \vdots & \vdots \\ d_{m1} & \cdots & d_{mm} \end{bmatrix}, \quad (8)$$

where D — is a matrix of deviations of the actual indicators from the normative ones,

d_{ij} — error of coincidence of actual and normative ratios between growth rates of i indicator and the growth rate of j indicator, at the same time $d_{ij} \in [0;1]$.

The elements of the matrix

D are calculated by the following constraint system (9):

$$d_{ij} = \begin{cases} 1, & \alpha_{ij} > 0 & \rho_{ij} < 0; \\ 1, & \alpha_{ij} = -1 & \rho_{ij} > 0; \\ 0, & \text{under other conditions.} \end{cases} \quad (9)$$

The resulting matrices make it possible to determine an integral indicator I , which characterizes the efficiency of financial management of the enterprise. The integral indicator is calculated using the formula (10):

$$I = S_c / S_\alpha \quad (10)$$

Components of the integral indicator S_c and S_α calculated by formulas (11) and (12):

$$S_c = \sum C \cdot \bar{B} \quad (11)$$

$$S_\alpha = \sum_{i=1}^m \sum_{j=1}^m |\beta_j \cdot \alpha_{ij}| \quad (12)$$

Where $\bar{B} = \begin{pmatrix} \beta_1 \\ \vdots \\ \beta_j \\ \vdots \\ \beta_m \end{pmatrix}$ — is the vector of the weighting

coefficients of the financial indicators of the innovative company. In order to determine the reserves for improving the efficiency of financial management of an innovation enterprise, it is advisable to determine the impact of individual factors, in particular the level of deviation of the partial financial result, which is reflected in a separate i indicator from the strategic objectives. The following formula (13) can be used for this purpose:

$$L(X_i) = \left(\sum_{j=1}^m \beta_j \cdot d_{ij} \right) \cdot S_\alpha^{-1}. \quad (13)$$

This approach makes it possible to carry out an integral assessment of the effectiveness of financial management of an innovative environmental enterprise. By analysing the impact of individual factors on the integral assessment, it is possible to identify the reserves for improving the effectiveness of financial management, because the elimination of deficiencies that prevent the achievement of strategic objectives will lead to an increase in the effectiveness of the management system. The advantage of the proposed methodology is that the accounting records can serve as a source of information and the calculated integral indicator provides additional information for more adequate management decisions.

3. Results and Discussion

The study of the effectiveness of financial management took place at four companies (N_1, N_2, N_3, N_4), which carry out innovative activity, in particular implementing measures of green production. The following financial indicators were selected to assess the effectiveness of the financial management of the individual company, as shown in Table 1.

In the context of assessing the effectiveness of financial management of an innovative environmental enterprise, it is advisable to analyse, in addition to the main financial indicators, the indicators that characterise the innovative and environmental activities of the enterprise. For example, costs related to the payment of penalties for violations of environmental legislation; losses related to eco-destructive impacts; the cost of current assets necessary for the implementation of environmental protection works;

Table 1

Financial indicators selected for analysis of financial management effectiveness

<i>i, j</i>	Indicator	Symbolic designation
1	Cost of goods sold	f1
2	Net income	f2
3	Net income from sales of products (goods, works, services)	f3
4	Operating profit	f4
5	Assets	f5
6	Administrative expenses	f6
7	Selling expenses	f7
8	Labour costs	f8
9	Material costs	f9
10	Operating costs	f10
11	Long-term liabilities	f11
12	Current liabilities	f12
13	Current assets	f13
14	Non-current assets	f14
15	Equity	f15
16	Cash	f16
17	Receivables	f17
18	Environmental mandatory payments and fines: expenses on payment of fines related to destructive environmental impact and violation of environmental legislation; losses related to destructive environmental impact	f18
19	Production greening costs: the cost of current assets required to implement environmental protection activities; repair, maintenance and depreciation costs for environmental equipment; costs of innovative activities related to greening; maintenance and disposal of eco-destructive waste	f19
20	Expenditure on the development and implementation of innovative technologies	f20
21	Net income generated from the implementation of innovative projects	f21

Source: compiled by the author

costs of repair works, maintenance and depreciation of environmental equipment; costs of innovative activities related to greening; costs of maintenance and disposal of harmful waste; costs of development and implementation of innovative technologies; income received from the implementation of innovative projects.

After selecting the financial indicators for analysis, the next step is to build the target matrices A_{n1} , A_{n2} , A_{n3} , A_{n4} for the surveyed enterprises N_1 , N_2 , N_3 , N_4 respectively. The target matrices should reflect the goals of financial strategies for the year 2021. The constructed target matrices are presented in Table 2.

It is important to note that only at enterprise N were the boundary coefficients applied $k_{21\ 5} = 0,05$ and $k_{21\ 20} = 0,03$.

The next step was to build the results matrices R_{n1} , R_{n2} , R_{n3} , R_{n4} , which characterise the actual implementation of the financial strategies of the enterprises. The results matrices are presented in Table 3.

In the next step, compliance matrices C_{n1} , C_{n2} , C_{n3} , C_{n4} , were calculated to assess the extent to which the objectives of the company's financial strategies have been achieved. The calculated compliance matrices are shown in Table 4.

In the interim stage of identifying reserves for improving the efficiency of the company's financial

management, deviation matrices were constructed D_{n1} , D_{n2} , D_{n3} , D_{n4} . The constructed deviation matrices are shown in Table 5.

The proposed approach involves the calculation of an integral indicator to assess the effectiveness of financial management of the enterprise. So at the enterprise N_1 the integral index is equal to:

$$I_{n1} = \frac{3.362}{13.388} = 0.251.$$

The obtained value is much lower than 0.5, i.e. the objectives of the financial strategy were achieved by 25.1%. This is a critically low level of efficiency and requires revision of the financial strategy of the enterprise.

For company N_2 the integral index is equal to $I_{n2} = 0,515$, for company N_3 the integral index is equal to $I_{n3} = 0,468$, for company N_4 the integral index is equal to $I_{n4} = 0,659$.

That is, the highest level of financial management efficiency is at enterprise N_4 , a slightly lower level of efficiency is at enterprises N_2 and N_3 . The lowest level is at N_1 .

In order to improve the efficiency of financial management, it is advisable for all companies to analyse the level of variance for individual financial indicators. The results of the calculation of the levels of variance for individual financial indicators for companies N_1 , N_2 , N_3 , N_4 are shown in Table 6.

Source: Calculated by the author

Compliance matrices for companies N_1, N_2, N_3, N_4

$C_{n_1} =$	0000000000000000000111 0001000000000000010000 0001100000000000010000 0100000000000000010000 0000000010000000010000 0000000100000000000101 0000000000000000001101 0000010000000000000000 0000100000000000000000 0000000000010001000000 0000000000000000000000 0000000000000000000000 0000000001000000000000 0000000000000000000000 000000000100100011110 0010000000001000000001 0000000000000000000000 000000000100100011110 011110000000000100001 000000100000100100111 100001100000100101010 100000000000100101100 101101100000010011000	$C_{n_2}N_1,N_2,N_3,N_4 =$	0100000000000000000100 101110001101111111011 01001000010111111010 01000000000010001001 0110000000000000000000 000000110000000000100 0000010000000000000100 0000010000000000000000 010000001000000000100 011000001000000000110 000000000001111111111 011000000010100010110 011000000011010011000 011100000010100000001 011000000010000000000 0110000000100000001000 011000000011000000000 011100000010100100111 100001101111000001000 011000000111000001000 010100000010010001000
$C_{n_3} =$	011100000010000000111 100000000100000011101 100100000100000011100 101010000100111011110 000100000100000010000 0000000100000000000000 0000000000000000000001 0000010000000000000000 0000000000000000000101 011110000001111100010 000000000001111100010 000000000110000000000 000100000110010101110 000100000010100000000 000100000110000000000 000000000110100011110 011110000000000100000 011100000000100100111 011100001000100101010 100100000110100101100 010000101000000001000	$C_{n_4} =$	011100000010000000011 101110000111110011111 110100000110000001111 111000000101110011110 010100000100010010000 0000000000000000000000 0000000000000000000001 0000000000000000000000 000000000000000000101 011110000000111100111 111000000000001110011 010100000000110000000 010100000000001101110 010100000001000000000 000000000111100000000 000000000110100011110 010110000110000100000 011100001000100100011 011100000000100100011 11110000110100101101 111000101110000001110

Source: Calculated by the author

Table 5

Deviation matrices for companies N_1, N_2, N_3, N_4

$D_{n1} = \begin{bmatrix} 0111000000000000000111 \\ 101011111101111101111 \\ 110001111101111101111 \\ 101011111101111101111 \\ 0111000001000101000001 \\ 011100101000000001000 \\ 011101000000000000000 \\ 011100000000000000001 \\ 011100000100000001101 \\ 011110001000111011111 \\ 000000000000000000000 \\ 011100000001110111111 \\ 011100000101001010001 \\ 010110000001000000000 \\ 011100000101100000001 \\ 011110000000000000001 \\ 000000000101100000000 \\ 011101001101000000000 \\ 011100001101000000001 \\ 011100000101000000001 \\ 010010011101101100110 \end{bmatrix},$	$D_{n2} = \begin{bmatrix} 001100000000000000011 \\ 000000000000000000100 \\ 100100001000000000101 \\ 101010001101101110110 \\ 000100001100010110001 \\ 000000001000000001001 \\ 000000000000000001001 \\ 000000000000000000001 \\ 001110000000000001001 \\ 100110000001111111001 \\ 000000000000000000000 \\ 000100000100011001001 \\ 000100000100001101111 \\ 000010000001000000000 \\ 000100000101100000001 \\ 000110000100100010111 \\ 000110000100000100001 \\ 000001101101000000000 \\ 011100000000100100011 \\ 100100000000100100101 \\ 101011111101101110110 \end{bmatrix},$
$D_{n3} = \begin{bmatrix} 000000000000000000000 \\ 001110000011111100010 \\ 010010000001111100011 \\ 010000000001000100001 \\ 011000000000010100001 \\ 000000100000000001001 \\ 000001000000000001000 \\ 000000000000000000001 \\ 000000000100000001000 \\ 000000000100000001101 \\ 110000000000000001101 \\ 011100000000111011111 \\ 011000000001001010001 \\ 011010000001000000001 \\ 011000000001100000001 \\ 011110000000000000001 \\ 000000000111100000001 \\ 000001101111000000000 \\ 100000000111000000001 \\ 011000000001000000001 \\ 101111010111111110000 \end{bmatrix},$	$D_{n4} = \begin{bmatrix} 0000000000000000000100 \\ 0000000000000001100000 \\ 000010000001111110000 \\ 0000000000000001100001 \\ 001000000000000100001 \\ 000000110000000001001 \\ 000001000000000001000 \\ 000001000000000000001 \\ 000000000100000000100 \\ 000000000100000001100 \\ 000000000000000001100 \\ 001000000000100011111 \\ 001000000001010010001 \\ 001010000000100000001 \\ 011100000000000000001 \\ 011110000000000000001 \\ 001000000001100000001 \\ 000001100111000000100 \\ 100000000111000001000 \\ 000000000001000000000 \\ 000111010001111110000 \end{bmatrix},$

Source: Calculated by the author

Table 6

Levels of deviation for selected financial indicators for enterprises N_1 , N_2 , N_3 , N_4

Indicator	Enterprise			
	N_1	N_2	N_3	N_4
f1	0,029	0,019	0,000	0,004
f2	0,057	0,004	0,038	0,008
f3	0,054	0,022	0,038	0,028
f4	0,057	0,044	0,028	0,016
f5	0,029	0,030	0,028	0,012
f6	0,026	0,015	0,013	0,016
f7	0,020	0,011	0,006	0,008
f8	0,023	0,007	0,006	0,008
f9	0,032	0,022	0,006	0,004
f10	0,049	0,041	0,019	0,012
f11	0,000	0,000	0,032	0,008
f12	0,043	0,026	0,051	0,028
f13	0,034	0,030	0,032	0,020
f14	0,017	0,007	0,028	0,016
f15	0,000	0,022	0,028	0,024
f16	0,026	0,033	0,032	0,028
f17	0,009	0,022	0,019	0,016
f18	0,029	0,018	0,019	0,024
f19	0,032	0,030	0,022	0,024
f20	0,029	0,026	0,025	0,000
f21	0,034	0,055	0,060	0,036

Source: Calculated by the author

The analysis of deviation levels indicates that enterprise N_1 needs to focus its efforts on enterprise profitability management because the highest levels of deviation 0.057, 0.057, 0.054 are characteristic of indicators f2, f4, f3 respectively. For enterprises N_2 , N_3 , N_4 the reserves for increasing the efficiency of financial management are also within the limits of profitability management, however, it is advisable to focus on innovative activity and its profitability because high levels of deviation 0.06 0,06 (N_3), 0.055 (N_2), 0.036 (N_4) are determined for indicator f21. Also for enterprise N_3 , it is advisable to increase the efficiency of current enterprise liabilities management, because for f12 the deviation level is 0.51.

4. Conclusions

In today's environment, companies' innovative activities help to solve both environmental and economic problems and contribute to the country's sustainable development. To achieve a competitive advantage in the global marketplace, for national enterprises it is necessary to ensure the transition to an innovation-oriented business model. However, for many enterprises, the introduction of environmental innovations is associated not only with gaining advantages, but also with certain risks, in particular, with a decrease in profitability due to increased costs of greening production. The main factors complicating greening are: reduced state

incentives and support for innovation activity; a lack of sufficient sources of funding for the development and implementation of innovation, and imperfect human rights legislation. In such circumstances, the role of a company's financial management, in particular, the evaluation of the effectiveness of cash flow management is growing. After all, assessing the effectiveness of financial management allows you to identify deficiencies in the management system and eliminate them.

In order to assess efficiency, it is advisable to use the methodology proposed, which involves analysing structural changes in the financial results of an innovative enterprise.

The current study assessed the financial management efficiency of four innovative enterprises using the proposed methodology. According to the results of the analysis, the efficiency level in the two enterprises is below 0.5, which indicates the need for immediate measures to improve the efficiency of financial management, in particular by improving the profitability management of the enterprise. The efficiency level of the other two enterprises is between 0.5 and 0.6. For these enterprises, the reserves for improving the efficiency of financial resources management are in the area of profitability management of innovative activities and current liabilities. The search for an optimal set of financial indicators could be the subject of further research.

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МОДЕЛЮВАННЯ СТРАТЕГІЇ ФІНАНСОВОГО УПРАВЛІННЯ ІННОВАЦІЙНОГО ЕКОЛОГІЧНОГО ПІДПРИЄМНИЦТВА

Анотація. *Сучасні умови функціонування підприємництва характеризуються високим рівнем невизначеності, зокрема значними флуктуаціями ринкової кон'юнктури, загостренням конкурентної боротьби та актуалізацією безпекових аспектів функціонування. Крім того, значний антропогенний вплив на довкілля та його руйнівні наслідки має результатом зростання суспільного попиту на екологізацію господарської діяльності. Тож інноваційна діяльність підприємства є відповіддю на виклики сучасності. Проте інноваційна діяльність в контексті підприємництва пов'язана з додатковими ризиками. Таке агресивне функціональне середовище вимагає від підприємств забезпечення високого рівня ефективності управління, зокрема зростає роль фінансового менеджменту. Саме завдяки ефективному управлінню фінансовими потоками інноваційному підприємству вдається досягти мінімізації фінансових ризиків та максимізації прибутку.*

Дослідження здійснено на базі фінансової звітності, яка характеризує підприємницьку діяльність інноваційного підприємства. Аналіз отриманих даних дозволив оцінити ефективність системи управління фінансовими потоками інноваційного підприємства та визначити резерви підвищення ефективності фінансового менеджменту. В процесі дослідження були використані статистичний та компаративний методи аналізу, статистичного моделювання та абстрагування.

Оцінка ефективності фінансового менеджменту є критично важливим елементом системи управління, який дозволяє виявити та усунути недоліки управління. В результаті дослідження була розроблена методологія оцінки ефективності фінансового менеджменту інноваційного екологічного підприємства.

Здійснення інноваційної діяльності, зокрема екологізація господарської діяльності, вимагає від підприємства забезпечувати ефективне управління ресурсами підприємства, зокрема фінансовим станом. Розробка та імплементація високоефективного механізму управління фінансовими процесами, який дозволяє реалізовувати цілі підприємства, є запорукою виживання підприємства в сучасних умовах. Одним із інструментів вдосконалення системи управління фінансовим станом підприємства виступає оцінка ефективності фінансового менеджменту.

Ключові слова: *фінансовий менеджмент, ефективність, інноваційне підприємництво, інтегральна оцінка, екологія, резерви, система.*
