Modeling the optimal management of the distribution of profits of an oil and gas company taking into account risks

Inesa Khvostina[1[0000-0001-5915-749X]], Viktor Oliinyk[2[0000-0001-6251-3846]], Valerii Yatsenko[2[0000-0003-2316-3817]], Liliia Mykhailyshyn[3[0000-0001-7944-5317]] and Uliana Berezhnytska[1[0000-0001-5354-8502]]

[1] Ivano-Frankivsk National Technical University of Oil and Gas, 15 Karpatska Str., Ivano-Frankivsk, 76019, Ukraine
inesa.hvostina@gmail.com, bi_if@ukr.net
[2] Sumy State University, 2 Rymskogo-Korsakova Str., Sumy, 40000, Ukraine
oliynyk.viktor@gmail.com, v.yatsenko@uabs.sumdu.edu.ua
[3] Vasyl Stefanyk Precarpathian National University, 57 Shevchenka Str., Ivano-Frankivsk, 76000, Ukraine
lilya-m@ukr.net

Abstract. This article discusses the optimal management of the distribution of the net income of an oil and gas company, taking into account risks. The utility function for the investigated enterprise acts as an optimality criterion. The control parameter is the distribution of the shares of net income for its optimal distribution in the selected areas. As a numerical implementation of the proposed algorithm, the activity of a catch oil and gas enterprise in the period 2018-2022 is considered. The optimal distribution of the received net income is given taking into account the discount rate and deductions to the State budget of Ukraine. The proposed algorithm can be used for optimal management of the company's financial activities.

Keywords: modeling, optimization, management, profit.

1 Introduction

An existing enterprise of the oil and gas complex in modern conditions should pay special attention to risk management. The main goal of the company is to maximize profit. Achievement of this task will be possible only if all risks affecting the operation of the enterprise are considered. The authors [10; 46] show that the SARS-CoV-2 coronavirus that causes the COVID-19 leads to uncertainty in various areas of economics, finance, risk management, social development, etc. They review scientific materials, according to the study the impact of COVID-19 on global health security, business risk management and other areas.

Risk management needs to be coordinated across the organization. All types of risk, both internal and external, should be managed in a comprehensive manner. One of the

approaches to reduce the risk of an enterprise is to predict the occurrence of a risk event and take appropriate measures to reduce it. Here the problem arises in the allocation of appropriate funds to prevent a risk situation. This study allows you to obtain the optimal distribution of cash flows required to reduce possible risky transactions. The total amount of necessary funds is taken as a part of the profit received, i.e. the optimal distribution of the company's profits also takes into account measures to reduce the degree of risk at the enterprise. The ability to optimally manage risky operations allows top management to obtain financial stability, competitiveness and stable profitability of an oil and gas company.

2 Literature review

Socio-economic instability, which is manifested at the present time, suggests that enterprises should devote the most important role to risk management in order to ensure a stable financial and economic condition of the enterprise. Ernst & Young reports the most important types of risks that occur in the activities of an oil and gas company [37; 48]. In [45], an analysis of the activities of oil and gas companies from the Fortune 500 list is carried out: ExxonMobil, Chevron, ConocoPhillips, Baker Hughes, Valero Energy, and Frontier Oil Corporation. The authors deeply analyze the types of risks that exist in the activities of these companies, including those associated with an increase in production capacity. This analysis allowed to diversify the risk portfolio and improve the financial stability of the company.

Many economists pay special attention to the problem of risk management and in their works reflect the basic concepts of the methodology and practice of risk management. To assess the external risks of foreign economic activity of an enterprise in [31], it is proposed to apply a three-dimensional model for assessing and identifying risks, as well as to use a tabular description of the enterprise's activities. The authors in [40] presented a scientific approach for assessing the external economic security of an enterprise. The main mechanisms for managing the anticipated risks and the stages of the implementation of the task are proposed. This approach allows a comprehensive approach to assessing the external economic security of an enterprise.

In [16], the authors consider synergetic models in the management of oil and gas companies. The types of models for describing and predicting oil and gas development are analyzed – exponential, logistic, allometric, Kohlrausch, hyperbolic are analyze. It is proved that synergetic models more fully and adequately describe the processes that take place in the integrated systems of strategic management of oil companies.

The technology of teaching risk management using a business game is considered in [6]. It is believed that in order to improve the qualifications of employees of the enterprise, it is necessary to use interactive methods of training, which will make it possible to further reduce operational and other types of risks. In [49], the authors explore the possibility of applying the theory of dynamic knowledge creation for training corporate employees. To obtain the most productive result, it is proposed to combine the relationship between dynamic knowledge creation and the learning process

at the enterprise. This approach leads to a decrease in the operational risk of the enterprise.

The authors of [7] propose a methodology for considering alternative strategies for controlling business processes associated with risk reduction. The characteristics of the methods of risk research, as well as their level of practical use are given. In [5], a discrete dynamic problem of managing the innovation process at an enterprise is considered, taking into account risks. To manage technological innovations at the enterprise, a phase vector of three components is built. The constructed model makes it possible to predict data when constructing optimal processes. The innovation process at the enterprise, described by the discrete dynamic model [3], is investigated. The proposed algorithm assumes the management of parameters of the influence of the activities of the enterprise, as well as the consideration of various risks. The model of operational management of the enterprise activity based on the task of adaptive management has been developed. Optimal management of investment flows of an enterprise is considered in [35].

For enterprise management, an algorithm for modeling a multi-criteria function was proposed [27]. A system of indicators has been built that allows evaluating the activities of an enterprise based on an integrated index. This indicator is based on a partial utility function. The proposed methodological approach takes into account the main characteristics of the enterprise's activities with the possibility of their classification and systematization. In [14], the issues of the emergence of diversification risks at the enterprise are considered. Analysis of factors is carried out. which affect these risks in the economic activities of the enterprise. The systematization of the causes of the emergence of risks and their possible consequences, depending on the strategy of the enterprise is carried out.

In [25], the political risk to security in an oil and gas company is considered. The authors show that there are risks at different levels: transnational, national and the level of human security. Investing in an oil and gas company depends on the risk management strategy. Due to the increased frequency of terrorist attacks in oil and gas companies, it is proposed to pay more attention to the risk of political security and apply an integrated approach to risk management.

In [20], an approach to risk assessment is proposed, taking into account the properties of emergence and re-emergence in the process of risk assessment to prevent and predict the risks of the activities of oil and gas enterprises. Taxonomic procedures and methods of factor analysis were identified, taking into account the properties of emergence, which will allow for a comprehensive assessment of risks and create a foundation for their assessment and forecast of their dynamics.

One of the methods of risk prevention is to eliminate the source of risk through specific measures. A narrow approach is to prevent risk through insurance premiums. The insurer is the initiator of this approach. Insurance companies create an optimization portfolio of financial instruments taking into account risk minimization [21; 36].

In [28], an approach was developed to assess the index of economic stability of an enterprise, based on an integral indicator. For the study, the authors used fractal analysis in combination with elements of the theory of a fuzzy set. The proposed method makes it possible to assess the effective activity of an enterprise in conditions of incomplete

information. In [9], the authors suggest paying special attention to risk management issues. This is due to the fact that business decisions are always made in the presence of certain types of risk and optimal risk management leads to their reduction. This is especially true for long-term investment in an oil and gas company, since the amount of investment may exceed US $ 1 billion.

The authors of [11] use Vector Autoregressive (VAR) and Vector Error Correction Models (VECM) to study the impact of a jump in oil prices on stock returns in 12 European countries that import oil. It was shown that the real profitability of stocks depends on the reasons for the jump in oil prices. The performance of most European stock markets is negative in relation to the change in oil prices and is mainly determined by oil supply shocks.

The amount of products produced in the oil and gas complex should be optimal from the point of view of its implementation. If this condition is violated, an imbalance occurs in the country's energy system. In [15], the authors used an improved methodological approach to assess the energy independence of the country and regions. In studies, to analyze the energy dependence of some fear of the world, the coefficient of covering consumption by the production of fuel and energy resources was used. On the basis of the integral indicator of energy independence, a comparative analysis of the regions by the level of energy was carried out. The authors in [8] investigated the volatility of the stock market and the oil market. They considered volatilities of two types: implied and realized volatilities. It is shown that the relationship between volatility is present only for implied volatility.

An in-depth analysis of the financial risk of manufacturing companies is presented in [17]. It is shown that Chinese listed companies have gone bankrupt due to market competition. This happened due to the crisis of financial risks, which becomes more and more complex with the development of society. The authors propose a new concept of financial risk in a manufacturing enterprise, which involves risk management mechanisms.

The work [13] is devoted to a comparative analysis of the complexity of traditional stock indices and social responsibility indices using the example of Dow Jones Sustainability Indices and Dow Jones Industrial Average. A comprehensive assessment of complexity reveals the nature of the effectiveness of social responsibility indicators and opens up new opportunities for investor risk management.

In [18], the risks associated with the redistribution of rental relations between the state, the region and the mining company are considered. The identified risks were grouped using the expert method and their importance was assessed. The results obtained suggest the optimization of the use of natural resources, taking into account the risk minimization strategy. The work [47] considers the counterparty risk associated with its default. The authors propose a model for quantifying credit adjustment without the assumption of independence between default and exposure. An analysis of the activities of corporations to ensure their competitiveness is presented in [24]. In modern conditions, with the advent of new information and innovative technologies, both the level of competition in the financial market and the transformation of risks are increasing. The development and practical implementation of innovative projects

should be integrated into a dynamic competitive business environment and rely on advanced information technology.

The authors in their work [26] analyzed the impact of enterprise risk management on the financial performance of 12 companies. It has been shown that the best indicators of profitability, liquidity and productivity improvement of a company occur when there is oversight of the enterprise risk management department by the company's Board of Directors. Depending on the size and complexity of the company, a more complex enterprise risk management framework needs to be employed. Particular attention is paid to the relationship between enterprise risk management and the audit committee, senior management and the chief risk officer [30]. To study the mutual influence, a non-experimental correlation approach was used. Based on correlation and regression analyzes, it is shown that the effectiveness of enterprise risk management depends significantly on the opinion of the risk director, the presence of an audit committee and the support of senior management. In [22; 23], attention was paid to modeling the assessment of the tax consciousness of tax subjects under conditions of uncertainty and risk. Based on the results of the study, the optimal combination of tax structural components of consciousness is calculated to maximize its level and reduce tax risks arising in the process of functioning of the state and taxpayer organizations.

The activity of any enterprise, especially oil and gas, is aimed at increasing the economic potential of the country. One of the main indicators is GDP. Forecasting and control of its components are presented in works [29; 34]. To predict macroeconomic indicators, artificial intelligence methods are widely used, in particular, neural networks and elements of the theory of fuzzy logic [32]. Noteworthy is the original approach to modeling the economic indicators of different countries, when initially all countries are segmented into a number of clusters based on key features, each of which unites countries according to the type of behavior. And already within the framework of each individual cluster, forecasting models of the studied macroeconomic indicators are built. This approach can be used in modeling and forecasting the performance indicators of an oil and gas company.

One of the main criteria for the operation of an oil and gas enterprise is resource security [39], which consists of economic actors, environment and purposeful economic process. Risk analysis and management is carried out in order to optimize national resource security. Based on the research, a comprehensive mechanism for supporting innovative research and the safety of technological resources was developed.

In modern conditions, new information technologies come to the fore in production activities. One of the areas of product implementation is electronic commerce [42]. The authors assess the impact of e-commerce on enterprise profits. A comparative analysis of traditional enterprise trade and electronic commerce is carried out. The work developed a model of price competition between companies. A model of a mixed strategy of a company for the sale of goods is considered. In [44], the Salop model with symmetric product differentiation is considered to analyze the expansion of the e-commerce market. The paper shows that the seller's income increases proportionally with the number of buyers. The analysis of advertising costs increases cubically with the number of buyers. The analysis of the optimal advertising costs in the competitive equilibrium model with free access is carried out. The ability to predict product sales is

possible based on the Bass model [33]. This model allows you to get the maximum profit for the enterprise at the best price.

In [41], based on the definition of the integral indicator, a model of socio-economic development is investigated. The research uses the methods of factorial, correlation and regression analyzes, as well as the method of expert estimates. The proposed algorithm allows you to efficiently analyze data and obtain adequate integral indicators, incl. and at the enterprises of the oil and gas complex.

A comprehensive study of enterprise innovation processes is especially relevant in the current Industry 4.0 environment [4]. This paper proposes an algorithm for creating a model for managing innovation at an enterprise based on a multi-criteria optimization problem. In a comprehensive study of enterprise risks, it is necessary to take into account the risks associated with IT technologies [2]. Informatization and computerization of production processes suggests that this type of risk is relevant and its study requires due attention. For the successful operation of an enterprise, it is necessary not only to produce products, but also to find consumers. For the prompt processing of information at the enterprise, it is necessary to have software that allows the creation and processing of large volumes of information. In [19], a technology for storing and processing data is proposed.

In [43], a three-level information system for managing business processes was developed. The web-application includes the necessary functional blocks for e-commerce. This system allows for electronic interaction between sellers and buyers.

Analysis of the scientific, theoretical and practical results of the study shows that it is necessary to conduct additional research on the integrated management of enterprise risks in order to optimize them.

The methodological basis of this research is the following scientific research methods: statistical analysis; correlation and regression analysis; factor analysis; simulation modeling; optimization theory; the Pontryagin maximum principle.

3 Discussions and results

The result of this study is to find the optimal management of the distribution of the net profit of an oil and gas company. The study of historical data allows you to obtain a regression equation that reflects the dependence of the company's net profit $P(t)$ on independent variables. The indicators reflecting the areas of use of net profit act as independent factors. Let's represent the regression equation in the form:

$$P(t) = a_0 + \sum_{i=1}^{n} a_i X_i\,(t) \tag{1}$$

where a_0 – is the free term in the regression equation; a_i – regression coefficients ($i = \overline{1,n}$); $X_i(t)$ – independent variables ($i = \overline{1,n}$).We will assume that the resulting linear regression equation for independent factors is adequate and its coefficients are significance.

Thus, we get that on the basis of historical data it is possible to predict the received profit of the company for future periods. To do this, you need to use the regression equation (1). To obtain the necessary predicted data for independent variables, it is

necessary to use the laws of distribution of these variables, as well as external and internal factors of influence on the operation of the enterprise.

The task is to determine the optimal use of net profit for transferring the system from the initial state to a given final state. The objective function is the utility function of the investigated enterprise. The management parameters are the shares of net profit aimed at achieving the assigned task. To solve the problem of optimal management of the distribution of the company's net profit, it is necessary to solve the following system of equations.

1. A system of differential equations:

$$\frac{dX_i(t)}{dt} = \mu_i X_i(t) + V_i(t), \ (i = \overline{1,n}) \tag{2}$$

where μ_i – rate of change of the i-th studied variable $X_i(t)$; $V_i(t) = \nu_i P(t)$ – management functions; ν_i – control parameters ($0 \le \nu_i \le 1, \ i = \overline{1,n}$; $\sum_{i=1}^{n} \nu_i \le 1$).

2. Initial conditions:

$$X_i(t_0) = X_i^0 \tag{3}$$

3. The utility function for the enterprise:

$$\int_{t_0}^{T} exp(-\delta\ t)\{1 - \sum_{i=1}^{n} exp[-\nu_i(t)P(t)]\}\, dt + \sum_{i=1}^{n} b_i X_i\,(T) \to max \tag{4}$$

where b_i – coefficients of the variables under study at a finite time T (obtained from the transversality condition); $\delta = ln(1 + i)$ – interest accrual rate; i – interest rate (discount) (%).

As a result, we obtain a mathematical model of the optimal distribution of the company's net profit. It is assumed that the independent variables are transferred from a given initial state to a given final state along an optimal trajectory with respect to the control parameters. To solve the resulting system (1) – (4), we use the Pontryagin maximum principle [1; 38].

Let us find a solution to the problem posed for the case of distribution of net profit in four directions and a linear regression equation. The main areas of use of net profit: X_1 – capital investment; X_2 – deductions for social events; X_3 – costs of monitoring the operation of underground gas storage (UGS); X_4 – deduction to the State budget of Ukraine. In the model, we assume that the deduction to the State Budget of Ukraine is a constant percentage of the company's net profit. In the further listed implementation, we will consider several possible options (30%, 40%,45%).

To solve the problem, we construct the Hamiltonian function:

$$H(t) = \sum_{i=1}^{3} \Psi_i(t)(\mu_i X_i(t) + \nu_i(t)P(t)) + e^{-\delta t}\left(1 - \sum_{i=1}^{3} e^{-\nu_i(t)P(t)}\right) \tag{5}$$

where $P(t) = (1 - \nu_4)\pi(t)$; $\Psi_i(t)$ – auxiliary functions found from the system of differential equations (6):

$$\frac{d\Psi_j(t)}{dt} = -\{\mu_j \Psi_j(t) + (1 - \nu_4)a_j[\sum_{i=1}^{3} \Psi_i\,(t)\nu_i(t) + e^{-\delta t}e^{-\nu_i(t)P(t)}]\}, \left(j = \overline{1,3}\right), \tag{6}$$

Auxiliary functions must satisfy the transversality condition:

$$\Psi_i(T) = -b_i, (i = \overline{1,3}) \quad (7)$$

The optimal control parameters are as follows:

$$v_i^* = -\frac{ln(-\Psi_i(t))+\delta t}{P(t)}, (i = \overline{1,3}) \quad (8)$$

As a numerical implementation of the proposed algorithm, we will consider the activities of a conditional oil and gas enterprise. We will use the results of their activities in 2018 as initial data. Consider the options for distributing the company's net income for a five-year period. To solve this problem, it is necessary to set the numerical values of the independent variables in 2022. The initial data for the calculation are presented in table 1.

Table 1. Oil and gas enterprise activity data, thousand UAH

	Indicators	**2018**	**2022**
$\pi(t)$	Net income	329939	1250138
$X_1(t)$	Capital investment	80000	179920
$X_2(t)$	Contributions to social events	70092	105348
$X_3(t)$	Costs of control over the operation of USG	48475	116340
$X_4(t)$	Deduction to the State Budget of Ukraine, (30%)	98981	375041

Consider several options for the optimal distribution of net profit, depending on the fixed amount of distribution to the State Budget of Ukraine and the discount coefficient. For the numerical implementation, we assume that the initial conditions (3) have the following form: $X_i(2018) = 1, (i = \overline{1,3})$. We transform the regression equation (1) to the form:

$$\pi(t) = -0{,}3277 - 0{,}0364X_1 - 1{,}0299X_2 + 2{,}3941X_3 \quad (9)$$

Table 2 shows the optimal distribution of net profit in three areas, taking into account the discount rate equal to zero and deductions to the State Budget of Ukraine of 30% of the net profit received.

Table 2. Dynamics of financial flows of an oil and gas company 2018-2022 ($\delta = 0,\ v_4 = 0{,}3$)

Indicators	**2018**	**2019**	**2020**	**2021**	**2022**
$\pi(t)$	1	1,305	1,851	2,669	3,789
$X_1(t)$	1	1,141	1,388	1,754	2,248
$X_2(t)$	1	1,059	1,161	1,308	1,503
$X_3(t)$	1	1,155	1,431	1,841	2,400

Table 3 shows the optimal share distribution of net profit for the proposed areas of use without taking into account the discount coefficient when deducting 30%, 40% and 45% of the company's net income to the State Budget of Ukraine.

Table 3. Share distribution of net income of an oil and gas company 2018-2022 ($\delta = 0$)

Indicators	2018	2019	2020	2021	2022
			$\boldsymbol{\nu_4 = 0,30}$		
$\nu_1(t)$	0	0,099	0,139	0,145	0,136
$\nu_2(t)$	0	0,042	0,060	0,063	0,060
$\nu_3(t)$	0	0,107	0,153	0,160	0,150
			$\boldsymbol{\nu_4 = 0,40}$		
$\nu_1(t)$	0	0,099	0,122	0,111	0,094
$\nu_2(t)$	0	0,047	0,059	0,054	0,046
$\nu_3(t)$	0	0,166	0,205	0,189	0,159
			$\boldsymbol{\nu_4 = 0,45}$		
$\nu_1(t)$	0	0,125	0,177	0,184	0,173
$\nu_2(t)$	0	0,053	0,077	0,080	0,076
$\nu_3(t)$	0	0,137	0,194	0,203	0,191

Table 4 shows the optimal distribution of the share distribution of net income according to the proposed variables and the trajectory of financial flows, taking into account the intensity of interest accrual and contributions to the State Budget of Ukraine of 30% of net income.

Table 4. Dynamics of financial flows of an oil and gas company 2018-2022 ($\delta = 0{,}05$; $\nu_4 = 0{,}30$)

Indicators	2018	2019	2020	2021	2022
$\pi(t)$	1	1,399	1,983	2,772	3,789
$X_1(t)$	1	1,213	1,488	1,831	2,248
$\nu_1(t)$	0,134	0,137	0,125	0,110	0,096
$X_2(t)$	1	1,134	1,263	1,387	1,503
$\nu_2(t)$	0,137	0,088	0,055	0,034	0,021
$X_3(t)$	1	1,227	1,531	1,919	2,400
$\nu_3(t)$	0,131	0,145	0,138	0,124	0,110

Tables 1-4 show the optimal distribution of the company's net income in the period 2018-2022 depending on the deductions to the State budget of Ukraine and the discount factor. Analysis of the results obtained shows that the maximum share of deductions from net income excluding discounted flows falls on 2021, and taking into account the discounting factor falls on 2018.

4 Conclusions

From the point of view of economic efficiency, the developed model makes it possible to optimally distribute the profit of the enterprise, within the limited financial resources, to manage environmental risks. The cost of managing environmental risks does not increase compared to traditional profit sharing approaches. The developed model is applicable both for the entire system of enterprise risks that are interconnected and for individual environmental risks and industrial groups. This is achieved by taking into account in the model the amount of damage, and not the amount of risk. The use of the developed model will reduce the costs of risk management by 10-15% in conditions of uncertainty and, accordingly, increase the profit of the enterprise by 15-20%, which will generally increase environmental sustainability. It should be noted that losses from environmental disasters are the largest and most difficult to predict. Therefore, the optimal distribution of profits for risk management and efficiency from investment in safety will not only reduce costs, but also reduce the likelihood of unforeseen consequences that may affect the environment.

In this paper, we consider the problem of optimal management of the company's net income. The distribution of net income occurs in the most important areas of its use. One of the main directions is the use of the obtained profit to prevent possible damage from various risks. In this setting, a mandatory deduction to the State Budget of Ukraine is assumed. Optimal management of the company's income is simulated, with these deductions of 30%, 40% or 45%. Tables 2 and 3 show the distribution of net income for the period up to 2022 excluding the discount factor. Table 4 shows the dynamics of financial flows and the share distribution of the net income of the conditional oil and gas company, taking into account the discount factor and deductions to the State Budget of Ukraine in the amount of 30% of the net profit ($\delta = 0{,}05;\ \nu_4 = 0{,}3$).

This mathematical model can be used as a guideline for the adoption by the top management of the enterprise of a long-term plan for its development.

References

1. Aseev, S.M.: On some properties of the adjoint variable in the relations of the Pontryagin maximum principle for optimal economic growth problems. Proceedings of the Steklov Institute of Mathematics **287**(S1), 11–21 (2014). doi:10.1134/S0081543814090028
2. Babenko, V., Lomovskykh, L., Oriekhova, A., Korchynska, L., Krutko, M., Koniaieva, Y.: Features of methods and models in risk management of IT projects. Periodicals of Engineering and Natural Sciences **7**(2), 629–636 (2019). doi:10.21533/pen.v7i2.558
3. Babenko, V., Nakisko, O., Latynin, M., Rudenko, S., Lomovskykh, L., Girzheva, O.: Procedure of Identifying of the Parameters of the Model of Management of Technological Innovations in Economic Systems. 2019 IEEE International Scientific-Practical Conference Problems of Infocommunications, Science and Technology, PIC S&T 2019, **9061259**, 324–328 (2019). doi:10.1109/PICST47496.2019.9061259
4. Babenko, V.: Enterprise Innovation Management in Industry 4.0: Modeling Aspects. Emerging Extended Reality Technologies for Industry 4.0: Early Experiences with

Conception, Design, Implementation, Evaluation and Deployment. Ed. by Jolanda G. Tromp et al. A John Wiley & Sons, Inc., pp. 1-24 (2020). doi:10.1002/9781119654674.ch9
5. Babenko, V.: Formalization of the Model of Management of the Technological Innovations. CEUR Workshop Proceedings **2393**, 595–602 (2019)
6. Bashynska, I., Baldzhy, M., Ivanchenkova, L., Skliar, L., Nikoliuk, O., Tkachuk, G.: Game Risk Management Methods for Investment Portfolio Optimization. International Journal of Recent Technology and Engineering **8**(2), 3940–3943 (2019). doi:10.35940/ijrte.B1729.078219
7. Bashynska, I., Sokhatska, O., Stepanova, T., Malanchuk, M., Rybianets, S., Sobol, O.: Modelling the risks of international trade contracts. International Journal of Innovative Technology and Exploring Engineering **8**(11), 2815–2820 (2019). doi:10.35940/ijitee.K2313.0981119
8. Bašta, M., Molnár P.: Oil market volatility and stock market volatility. Finance Research Letters **26**, 204–214 (2018)
9. Berlin, A.: Managing Political Risk in the Oil and Gas Industries. Oil, Gas & Energy Law Intelligence 2. https://www.ogel.org/article.asp?key=140 (2003). Accessed 17 Aug 2020
10. Chang, C.-L., McAleer, M., Wong, W.-K.: Risk and Financial Management of COVID-19 in Business, Economics and Finance. J. Risk Financial Manag. **13**, 102 (2020)
11. Cunado, J., de Gracia, F.P.: Oil price shocks and stock market returns: Evidence for some European countries. Energy Economics **42**, 365–377 (2014)
12. Derbentsev, V., Matviychuk, A., Soloviev, V.N.: Forecasting of Cryptocurrency Prices Using Machine Learning. In: L. Pichl, C. Eom, E. Scalas, & T. Kaizoji (Eds.) Advanced Studies of Financial Technologies and Cryptocurrency Markets, pp. 211–231 (2020). doi:10.1007/978-981-15-4498-9_12
13. Derbentsev, V., Semerikov, S., Serdyuk, O., Solovieva, V., Soloviev, V.: Recurrence based entropies for sustainability indices. E3S Web of Conferences **166**, 13031 (2020). doi:10.1051/e3sconf/202016613031
14. Donecz, L., Prudnikova, L.: Risks of diversification of the economic activity of the enterprise. Problems and prospects of entrepreneurship development **1**, 16–20 (2011)
15. Dzwigoł, H., Dzwigoł-Barosz, M., Zhyvko, Z., Miskiewicz, R., Pushak, H.: Evaluation of the Energy Security as a Component of National Security of the Country. Journal of Security and Sustainability Issues **8**(3), 307–317 (2019). doi:10.9770/jssi.2019.8.3(2)
16. Fadyeyeva, I., Horal, L.: Application of modern modeling in system of strategic management at oil and gas companies. The Economic Annals-XXI Journal 1-2, 106–109 (2014)
17. Fang, F.: A Study of Financial Risks of Listed Manufacturing Companies in China. Journal of Financial Risk Management **5**, 229–245 (2016). doi:10.4236/jfrm.2016.54022
18. Halynska Y., Telizhenko A.: Risk in the formation of collaboration alliance of the redistribution natural rental income. Problems and Perspectives in Management **14**(4), 181–185 (2016). doi:10.21511/ppm.14(4-1).2016.06
19. Hrabovskyi, Y., Babenko, V., Al'boschiy, O., Gerasimenko, V.: Development of a Technology for Automation of Work with Sources of Information on the Internet. WSEAS Transactions on Business and Economics **17(**25), 231–240 (2020). doi:10.37394/23207.2020.17.25
20. Khvostina, N., Havadzyn, N., Horal, L., Yurchenko, N.: Emergent Properties Manifestation in the Risk Assessment of Oil and Gas Companies. CEUR Workshop Proceedings **2422**, 157–168 (2019)
21. Kozmenko, O., Oliynyk, V.: Statistical model of risk assessment of insurance company's functioning. Investment Management and Financial Innovations **12**(2), 189–194 (2015)

22. Kucherova, H., Pokataieva, O., Bilska, O.: Modelling tax consciousness evaluation in the context of economic development uncertainty. Periodicals of Engineering and Natural Sciences **7**(2), 567–579 (2019). doi:10.21533/pen.v7i2.565
23. Kucherova, H., Serhieieva, L., Bilska, O.: Matrix models for assessing the taxation subjects' interaction under uncertainty of socio-economic processes. CEUR Workshop Proceedings **2422**, 371–384 (2019)
24. Kwilinski, A., Dzwigol, H., Dementyev, V.: Model of Entrepreneurship Financial Activity of the Transnational Company Based on Intellectual Technology. International Journal of Entrepreneurship **24**(1S), 1–5 (2020)
25. Lambrechts, D., Blomquist, L.B.: Political-security risk in the oil and gas industry: the impact of terrorism on risk management and mitigation. Journal of Risk Research **20**(10), 1–18 (2017). doi:10.1080/13669877.2016.1153502
26. Li, L.: A Study on Enterprise Risk Management and Business Performance. Journal of Financial Risk Management **7**(1), 123–138 (2018). doi:10.4236/jfrm.2018.71008
27. Malyarets, L.M., Babenko, V.O., Nazarenko, O.V., Ryzhikova, N.I.: The Modeling of Multi-criteria Assessment Activity in Enterprise Management. Int. J Sup. Chain. Mgt. **8**(4), 997–1004 (2019)
28. Matviychuk, A., Novoseletskyy, O., Vashchaiev, S., Velykoivanenko, H., Zubenko, I.: Fractal analysis of the economic sustainability of industrial enterprise. CEUR Workshop Proceedings **2422**, 455–466 (2019)
29. Matviychuk, A., Strelchenko, I., Vashchaiev, S., Velykoivanenko, H.: Simulation of the Crisis Contagion Process Between Countries with Different Levels of Socio-Economic Development. CEUR Workshop Proceedings **2393**, 485–496 (2019)
30. Mensah, G., Gottwald, W.: Enterprise Risk Management: Factors Associated with Effective Implementation. Social Science Electronic Publishing, Amsterdam (2016)
31. Nesterova, K., Marchenko, V., Lazebnyk, I., Pavlova, V., Burkova, L., Omelchuk, L.: Identification And Assessment Of External Risks Of The Enterprise's Foreign Economic Activity. International Journal of Scientific & Technology Research **9**(2), 4672–4675 (2020)
32. Oliinyk, V., Kozmenko S.: Forecasting and management of gross domestic product. Journal of International Studies **12**(4), 214–228 (2019). doi:10.14254/2071-8330.2019/12-4/14
33. Oliinyk, V., Kozmenko, O., Wiebe, I., Kozmenko, S.: Optimal Control over the Process of Innovative Product Diffusion: The Case of Sony Corporation. Economics and Sociology **11**(3), 265–285 (2018). doi:10.14254/2071- 789X.2018/11-3/16
34. Oliinyk, V.: Optimal Management of GDP Components. Journal of Advanced Research in Law and Economics **IX**/2(32), 603–614 (2018). doi:10.14505/jarle.v9.2(32).24
35. Oliinyk, V.: Optimal Management of the Enterprise's Financial Flows. Journal of Advanced Research in Law and Economics **VIII**/6(28), 1875–1883 (2017). doi:10.14505/jarle.v8.6(28).22
36. Oliynyk, V.: Modeling of the optimal structure of insurance portfolio. Problems and Perspectives in Management **13**(2), 230–234 (2015)
37. Pitatzis, A.: Ernst & Young Report: Top 10 Risk and Opportunities for Oil and Gas Companies, a useful tool for strategic decisions for oil and gas managers. https://energyroutes.eu/2015/11/24/ernst-young-report-top-10-risk-and-opportunities-for-oil-and-gas-companies-a-useful-tool-for-strategic-decisions-for-oil-and-gas-managers/ (2015). Accessed 17 Aug 2020
38. Pontryagin, L.S, Boltyanskii, V.G, Gamkrelidze, R.V., Mishchenko, E.F.: The mathematical theory of optimal processes. Interscience Publishers John Wiley&Sons, New York-London (1962)

39. Prokopenko, O., Omelyanenko, V., Klisinski, J.: Innovation policy development conceptual framework for national resource security providing, Journal of Environmental Management and Tourism **9**(5),1099–1107 (2018)
40. Prokopenko, O.V., Domashenko, M.D., Shkola, V.Y.: Management features of economic security in foreign economic activity of ukrainian machine-building enterprises. Actual Problems of Economics **160**(1), 188–194 (2014)
41. Pursky, O., Dubovyk, T., Gamova, I., Buchatska, I.: Computation algorithm for integral indicator of socio-economic development. CEUR Workshop Proceedings **2393**, 919–934 (2019)
42. Pursky, O., Dubovyk, T., Moroz, I., Buchatska, I., Savchuk, A.: The price competition simulation at the blended trading market. CEUR Workshop Proceedings **2422**, 15–26 (2019)
43. Pursky, O., Selivanova, A., Dubovyk, T., Herasymchuk, T.: Software implementation of e-trade business process management information system. CEUR Workshop Proceedings **2546**, 171–181 (2019)
44. Pursky, O.I., Grynyuk, B.V., Shestopal, D.A.: Planning of advertising costs and vendor number at e-trade market. Actual Problems of Economics **177**(3), 407–413 (2016)
45. Rogers, V.C., Ethridge, J.R.: Enterprise Risk Management in the Oil and Gas Industry: An Analysis of Selected Fortune 500 Oil and Gas Companies' Reaction in 2009 and 2010. American Journal of Business Education **9**(1), 23–30 (2016)
46. Semerikov, S., Chukharev, S., Sakhno, S., Striuk, A., Osadchyi, V., Solovieva, V., Vakaliuk, T., Nechypurenko, P., Bondarenko, O., Danylchuk, H.: Our sustainable coronavirus future. E3S Web of Conferences **166**, 00001 (2020). doi:10.1051/e3sconf/202016600001
47. Slime, B.: Modeling and Quantifying of the Global Wrong Way Risk. Journal of Financial Risk Management **6**, 231–246 (2017). doi:10.4236/jfrm.2017.63017
48. Turn risks and opportunities into results: Exploring the top 10 risks and opportunities for global organizations. https://www.ey.com/Publication/vwLUAssets/The_top_10_risks_and_opportunities_for_global_organizations/$FILE/Business%20Challenge%20main%20report-%20SCORED.pdf (2011)
49. Xu, M.: Design of Enterprise Training Model Based on Dynamic Knowledge Creation. American Journal of Industrial and Business Management **9**(9), 1761–1771 (2019). doi:10.4236/ajibm.2019.99115