INTELLIGENCE ANALYTICAL SUBSYSTEM OF CORPORATE MANAGEMENT (ON THE EXAMPLE OF AN OIL & GAS COMPANY)

SCIENTIFIC RESEARCH GROUP:

Maxim Krasnyuk (iD)
Ph.D., Associate Professor
Department of Information Systems in Economics
Kyiv National Economic University named after Vadym Hetman, Ukraine

Iryna Hrashchenko (iD)
Ph.D., Associate Professor
Department of management of foreign economic activity of enterprises
Faculty of Transport, Management and Logistic
National Aviation University National Aviation University, Ukraine

Yurii Kulynych (iD)
Ph.D. of Economics, Associate Professor
Department of Finance
Institute of Economics and Management
National University of Food Technologies, Ukraine

Sydorenko Tetiana (iD)
PhD in Economics, assistant of professor
Department Hotel and restaurant bussiness
State University of Trade and Economy, Ukraine

Svitlana Krasniuk (iD)
Senior Lecturer
Institute of Law and Modern Technologies
Kyiv National University of Technologies and Design, Ukraine

Summary. *The changes that have taken place in the Ukrainian economy in recent years due to the consistent impact of global macroeconomic, epidemiological and military factors of the current deep crisis - actualized for enterprises and corporations a complex adaptive reorganization of their analytical subsystem of their management [1, 2].*
In addition, in order to be consistently effective in today's global business environment (liberalization of markets, their globalization, increased competition, decreasing consumer loyalty, constant variation in oil and gas prices, etc.), oil and gas companies must have an innovative data and knowledge environment that allows seamless and effective joint leveraging knowledge inside

СЕКЦІЯ V. МЕНЕДЖМЕНТ, ПУБЛІЧНЕ УПРАВЛІННЯ ТА АДМІНІСТРУВАННЯ

the corporation and across the value chain [3]. The application of knowledge-based decision support systems as an important tool of innovative management policy enables effective and sustainable management of a complex of integrated processes of an oil and gas production company (mitigating the impact of crisis factors) [4].

The scientific and practical results presented in the article regarding the methodology and design of innovative analytical subsystem of the corporation management information systems should be taken into account when reengineering corporate information systems not only in the oil and gas industry in Ukraine [5-6].

Moreover, the obtained results are relevant and applicable not only for local companies, but also for international corporations on emerging markets in the context of global and regional macroeconomic and edipemical crisis phenomena.

Keyword*s: management, analytics, information system, finance, oil & gas production company*

INTRODUCTION

The potential of Ukraine's oil and gas industry makes it possible to stabilize and, in the future, increase oil and gas production [7-8]. One of the necessary factors to increase the Ukrainian production of hydrocarbons is the improvement of the efficiency of the analytical management of the oil and gas company thanks to the application of effective economic and mathematical modeling at the strategic level of management and the use of knowledge-oriented decision support tools as an integral component of the complex corporate management system of the oil and gas company [9-10].

The organization of management of an oil and gas production company is significantly influenced by: the specifics of the main production processes; traditional economic specifics of the oil and gas industry; the transition of the domestic oil and gas complex from a centralized economy to a competitive market; main trends in the management of the global oil and gas industry.

It is possible to distinguish 3 levels of management of an oil and gas production company: technological (operational and accounting); tactical (reporting and planning); strategic. At the tactical and strategic levels of management, the greatest effect can be obtained today from the introduction of intelligent analytical information systems and technologies [11].

Management analysis in the oil and gas industry estimates the costs of transforming resources that can be technologically extracted and economically profitable (at a certain price level) into proven hydrocarbon resources, that is, it reflects the price for the search, development and production of a certain amount of estimated resources according to current technology and the existing scientific level understanding [12]. The main ultimate goal of the economic analysis of geological resources is a better understanding of the economic situation by the top management of the industry and the government. Economic models in oil and gas exploration are used to identify major trends rather than specific predictions. The most important conclusion of the economic analysis is that, taking into account the tendency of deposits to grow, in order to maintain production in countries with well-explored subsoil (in particular, Ukraine), a significant improvement of industrial technologies and the use of all possible innovations, including and in the field of information systems and information technologies [13].

The studied dependence of the intensification of oil and gas production on analytical information support shows the essential importance of intelligent information modeling in the management of an oil and gas company [14].

In the previous works of the authors, the results of the study of the influence of the following factors of analytical activity [15], in particular, the economic-mathematical modeling of the oil and gas company as a complete complex specific system are presented: significant inertia of the management object; multi-level management structure; irregularity of the management system of the oil and gas company; the need to decompose the system along the weakest lines of communication "vertically" and "horizontally" and build economic-mathematical models of smaller dimensions for each selected element.

Economic-mathematical modeling of the tactical level of management of an oil and gas company as optimality criteria involves maximizing profit and minimizing integral costs; and can be formalized in the form of economic-mathematical models of the following interconnected blocks: geological-industrial, production, transport and economic [16].

Economic and mathematical modeling of the strategic level of an oil and gas company should reflect the strategic goal of the company's development over a certain period of time, most often it is the maximum profit. However, in the conditions of constant changes in the global environment, the most stable position in the long term is the system that is characterized by maximum efficiency (and not profitability), which also depends on random factors (constant fluctuations in energy prices are the norm of the modern world economy) [17].

The problem of ensuring production and the growing renewal of hydrocarbon reserves must be solved by an oil and gas company by opening new deposits, the features of which largely determine the specifics of analytical activities in planning, process organization and the material and technical base for carrying out exploration work, determining the industrial value of explored reserves etc [18-21].

PROBLEM STATEMENT AND RELEVANCE OF THE RESEARCH

The production cycle of an oil and gas production company is as follows: discovery of a field, exploration, experimental and industrial exploitation, development and development, exploitation, conservation of the field. At different stages of its management, it is advisable to use various intelligent information systems and technologies. CAD systems are used in drawing up development projects. Classic DSS, which do not require a significant amount of calculations, are used at the stages of feasibility study and final stages of development. The database is created and maintained at all stages of the field's life cycle. And at the initial and final stages, it is necessary to use knowledge-oriented systems [22]. This is explained by the lack of necessary initial information, and therefore the need to rely on the knowledge of specialists; and the need to rely on the knowledge of engineering and technical personnel who have recently been engaged in well maintenance. Further expansion of the use of knowledge-oriented analytical methods to support management decisions is necessary to reduce risk at the stages of prospecting and development of hydrocarbon deposits.

THE MAIN PART

If we take into account the factor of the time horizon of management, the IS of an oil and gas production company can be divided into 3 levels: subsystems of

СЕКЦІЯ V. МЕНЕДЖМЕНТ, ПУБЛІЧНЕ УПРАВЛІННЯ ТА АДМІНІСТРУВАННЯ

technological process management (technological information) (SCADA (supervisory control and data acquisition) - a similar subsystem, or supervisory control and data collection); ERP (enterprise resource planning) type subsystem (OLTP - a similar subsystem, or enterprise resource planning and management system) (planning, economic and production information); analytical subsystem of top management (administrative and managerial analytical information and knowledge) (OLAP-like subsystem) [23].

All the listed three levels of management of an oil and gas production company should form a single system and be components of the corporate IS. Between these levels, there are direct (implementation of plans) and reverse (correction of plans due to a critical accumulated level of disturbances that are poorly amenable to operational management; formation of technical and economic indicators) connections [24].

It is the analytical subsystem of the oil and gas production company that is the main focus of the research and will be detailed below. The time horizon of the operation of the subsystem of the 3rd level of the oil and gas company is 5 years or more (in particular, the effectiveness of the planning of capital investments, innovations and personnel can be evaluated after a long period) [25]. Main tasks: formation of strategic goals, formation of production and investment strategy, strategic budget and financial planning, strategic management of capital structure, costs and quality, etc. It should be noted that although the greatest potential economic effect is associated with the implementation of this part of the corporate IS of an oil and gas company today, the issues of creating macroeconomic modeling tools and supporting strategic decision-making of an oil and gas company are practically unexplored today [26-27]. The insufficient level of implementation of knowledge-oriented technologies and other intellectual technologies into the management practice of oil and gas companies is also due to the fact that the open publication of the results of research and applications can significantly affect the current and future financial condition of the oil and gas production company [28].

In fig. 1. and fig. 2. the causes and consequences of ineffective knowledge management of an oil and gas company are reflected.

Fig. 1. **Reasons for inefficient knowledge management of an oil and gas company**
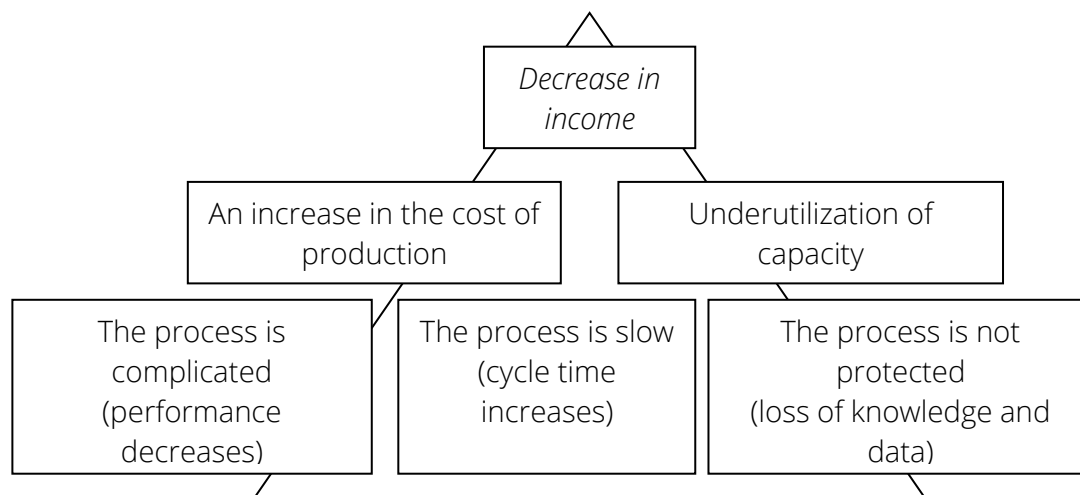
```
                          ┌─────────────┐
                          │ Decrease in │
                          │   income    │
                          └─────────────┘
           ┌──────────────────────┐   ┌──────────────────────┐
           │ An increase in the   │   │  Underutilization of │
           │ cost of production   │   │      capacity        │
           └──────────────────────┘   └──────────────────────┘
   ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
   │ The process  │  │ The process  │  │ The process  │
   │ is           │  │ is slow      │  │ is not       │
   │ complicated  │  │ (cycle time  │  │ protected    │
   │ (performance │  │ increases)   │  │ (loss of     │
   │ decreases)   │  │              │  │ knowledge    │
   │              │  │              │  │ and data)    │
   └──────────────┘  └──────────────┘  └──────────────┘
```

Fig. 2. **Consequences of ineffective knowledge management of an oil and gas company**

Examples of existing knowledge-oriented analytical systems in the world oil and gas production industry: Dipmeter Adviser (determination of reservoir structure), Drilling Adviser (diagnostics of the tool during drilling), LITHO (determination of petrophysical characteristics), EXPROD (diagnostics of pumping equipment), Mudman (selection of drilling fluid) - all of which are actually knowledge-oriented systems of engineering and technical direction, which confirms the relevance of knowledge-oriented support of macroeconomic decisions of an oil and gas company [29].

CONCLUSIONS

The maximum effect in the organization of knowledge-oriented management decision-making processes in the oil and gas industry can be obtained with an adaptive and intelligent DSS, which allows the maximum combination of procedural devices of various economic and mathematical models, decision-making and management support methods, and flexibly rebuilding to new types of information base at changed decision-making methods. DSS, which are based on flexible methods of presentation and processing of economic information, that is, information systems using the concepts of knowledge bases, have an undeniable advantage in this direction. Orientation to knowledge provides a double advantage: first, flexibility, meaningfulness and expressiveness of knowledge in the representation of a complex and unstructured system; secondly - the mobility and correctness of corporate knowledge bases when transitioning to new decision-making methods and the need to adapt to new conditions. In this way, knowledge-oriented DSS improve consistency in the decision-making process, help to implement business policies and adopted organizational regulations, explain the proposed solutions, which is very important if the staff is inexperienced or resists the proposed solution to the problem. The nature of human expertise includes the ability to find high-priority problems, explain results, learn from mistakes, if necessary, restructure the relevant knowledge, take into account common sense, sometimes break the rules and the property of gradual temporal degradation of the

quality of the decision made. No existing technology can satisfy all these requirements, and the way out is the further improvement and development of AI family technologies as a component of DSS.

The maximum effect in the organization of knowledge-oriented management decision-making processes in the oil and gas industry can be obtained with a flexible and mobile DSS, which allows the maximum combination of procedural devices of various economic and mathematical models and decision-making support methods and flexible restructuring to new types of information base. DSS with the application of concepts of knowledge bases have an undeniable advantage in this direction. In this way, knowledge-oriented DSS improve consistency in the decision-making process, help implement business policy and adopted organizational regulations, and explain proposed decisions.

PROSPECTS OF USE OF RESEARCH RESULTS

Liberalization of markets, globalization, increased competition, declining consumer loyalty, constant variation in oil and gas prices, the development of the Internet and mobile technologies, rising drilling and completion costs are forcing and simultaneously enabling energy companies in all energy sectors around the world to restructure and radically change way of doing business, focusing on innovative information management and total controlling and auditing of Big Data of the oil and gas company.

To be effective and successful in such a demanding business environment, oil and gas companies must have an open information technology environment that enables seamless and efficient knowledge sharing across the company and value chain. New knowledge-oriented IS AI architectures are necessary to maintain and increase profitability, the level of which will no longer be critically dependent on the level of oil or gas prices.

The ability of the management of an oil and gas company to collect, distribute and use the distributed knowledge of the company makes it possible to develop and implement processes and technologies that will improve the productivity of the oil and gas company and reduce its costs. It is because of the above-mentioned factors that an important factor in increasing hydrocarbon production on emerging markets is increasing the efficiency of knowledge management through the use of knowledge-oriented technology with elements of artificial intelligence. The application of knowledge-oriented decision support systems as a key tool of the knowledge management policy will make it possible to more effectively and comprehensively manage the complex of integrated processes of the oil and gas production company.

In addition to the above, a critical direction for the modern company is the use of knowledge-oriented DSS in the training of specialists in the exploration and development of oil and gas fields. It is necessary to begin now to find and collect the intellectual capital that will leave the industry, and to build decision simulators based on knowledge-oriented DSS, able to condense this knowledge and transfer it more effectively to the next generation of workers. Those oil and gas companies that take care of this in advance will be able to more effectively overcome crisis situations in the future and increase oil and gas production on emerging markets.

The theoretical provisions put forward in the work and the DSS project presented in previous publications by the authors are universal for implementation

by both state and private oil and gas companies of various sizes, resident and non-resident companies, however, so that a specific oil and gas company receives its own additional competitive advantages over others, additional profiled research and development is required.

In addition, it should be noted that the full-scale practical implementation of projects similar in terms of content, scope and complexity in the oil and gas industry, according to experts and according to the experience of the authors, takes several years for a highly experienced research team of a specialized consulting company.

References:

[1] Кулинич Ю. М. Теоретичні аспекти сутності категорії економічний розвиток підприємства в ринковому середовищі. *Науковий вісник БДФЕУ*. 2016. Вип. 1 (22). С. 426–433.

[2] Hrashchenko I. and Krasniuk S. (2015) Problems of regional development of Ukraine under globaliation process. *Visnyk Mizhnarodnoho humanitarnoho universytetu.* Seriia: Ekonomika i menedzhment, 2015. - №11. – p. 26-32.

[3] Микитенко, В. В., & Грищенко, І. С. (2008). Адаптивна система управління інноваційними процесами на підприємствах. *Проблеми науки,* (4), 32-37.

[4] Краснюк, М. Т. (2000). Досвід та проблеми іноземного інвестування у нафтогазовий комплекс України. *Матеріали VI Міжнародної науково-практичної конференції «Теорія управління: стан та перспективи»* – К.: КНЕУ, НТУУ "КПІ", С. 100.

[5] Hrashchenko Iryna, Krasnyuk Maxim, Krasniuk Svitlana (2020). Iterative methodology of bankruptcy forecast of logistic companies in emerging markets, taking into account global/regional crisis. *Збірник наукових праць «Проблеми системного підходу в економіці»*, Випуск 1 (75) / 2020. – С. 138-147. DOI:10.32782/2520-2200/2020-1-43

[6] Krasnyuk, M. & Kustarovskiy O. (2017). The development of the concept and set of practical measures of crisis logistics management in the current Ukraine conditions. *Management theory & practice*. Publisher : Warsaw Management University. 19 (1). 31-38 [in English]

[7] Краснюк, М. Т., & Гафич, О. І. (2010). Моделювання ризику участі компанії-інвестора в проектах пошуку і розвідки родовищ нафти і газу. *Економічний вісник Національного гірничого університету*, - 2010. - № 1. - С. 102-111. - Режим доступу: http://nbuv.gov.ua/UJRN/evngu_2010_1_17.

[8] Краснюк, М. Т., & Гафич, О. І. (2016). Моделювання процесу вибору перспективних інвестиційних об'єктів і формування ефективного портфеля проектів нафтогазовидобувного бізнесу. *Інвестиції: практика та досвід*, (7), 60-66.

[9] Краснюк, М. Т., & Гафич, О. І. (2007). Систематизація, моделювання та оцінка галузевих ризиків при техніко- та геолого-економічному обґрунтуванні інвестиційних проектів нафтогазовидобутку. *Моделювання та інформаційні системи в економіці*.—К.: КНЕУ, (76), 95-106.

[10] Krasnyuk, M. T., & Hafych, A. I. (2016). Simulation of selecting promising investment projects and the formation of an effective portfolio of oil and gas business. *Investment: Practice and Experience*. Kyiv, (7), 97-109, 2016.

[11] M. Krasnyuk, Yu. Kulynych, I. Hrashchenko, S. Krasniuk, S. Goncharenko, T. Chernysh. Innovative management information system in post-crisis economic conditions on emerging markets (on the example of the oil and gas industry) // *Moderní aspekty vědy -* Modern aspects of science : svazek XXXVII mezinárodní kolektivní monografie. – Česká republika : Mezinárodní Ekonomický Institut s.r.o., 2023. – P. 185-203.

[12] Maxim Krasnyuk, Iryna Hrashchenko, Svitlana Goncharenko, Svitlana Krasniuk, Yurii Kulynych (2023) Intelligent management of an innovative oil and gas producing company

under conditions of the modern system crisis. *ACCESS Journal:* Access Press Publishing House, Volume 4, Issue 3: 352-374. DOI: https://doi.org/10.46656/access.2023.4.3(2)

[13] Krasnyuk, M., Kulynych, Y., Tuhaienko, V., & Krasniuk, S. (2022) E-business and e-commerce technologies as an important factor for economic efficiency and stability in the modern conditions of the digital economy (on the example of oil and gas company). *Grail of Science.* – 2022. – №. 17. –69-81.

[14] Maxim Krasnyuk, Yurii Kulynych, Iryna Hrashchenko, Svitlana Goncharenko, Svitlana Krasniuk (2022) Economic and mathematical modeling of an oil and gas production company as an integrated complex specific system // Наука і техніка сьогодні, 2022. 399-413. DOI: https://doi.org/10.52058/2786-6025-2022-13(13)-399-414

[15] Krasnyuk M., Kulynych Yu., Tkalenko A., Krasniuk S. (2021). Methodology of Effective Application of Economic-Mathematical Modeling as the Key Component of the Multi-Crisis Adaptive Management. Modern Economics, 29(2021), 100-106. DOI: https://doi.org/10.31521/modecon.V29(2021)-16.

[16] Krasnyuk M., & Krasniuk, S. (2020). Intellectual analysis of geological and economic data of oil and gas company for classification of productive layers. *Матеріали конференцій МЦНД*, 7-8. https://ojs.ukrlogos.in.ua/index.php/mcnd/article/view/2974

[17] Краснюк, М. Т. (2014). Технологія використання інтелектуальних обчислень для аналізу геолого-геофізичної інформації з метою визначення економічно-обгрунтованих об'єктів (пластів) для подальшої промислової розробки. *Моделювання та інформаційні системи в економіці*, (90), 51-60. https://ir.kneu.edu.ua/handle/2010/7224

[18] Krasnyuk, M., & Krasniuk, S. (2020). Application of artificial neural networks for reducing dimensions of geological-geophysical data set's for the identification of perspective oil and gas deposits. *Збірник наукових праць ЛОГОΣ*, 18-19. https://doi.org/10.36074/24.04.2020.v2.05

[19] Krasnyuk, M., & Krasniuk, S. (2020). Efficiency of statistical methods of reducing the dimension of geological and geophysical attributes for exploration of prospective hydrocarbon deposits. *Збірник наукових праць ЛОГОΣ*, 69-71. https://doi.org/10.36074/05.06.2020.v3.29

[20] М.Т. Краснюк (2014). Застосування нейромережевого підходу для виділення рентабельних перспективних пластів у наявному фонді свердловин української нафтогазовидобувної компанії. *Науковий вісник НЛТУ України*, 24 (5), 370-383. - Режим доступу: http://nbuv.gov.ua/UJRN/nvnltu_2014_24.5_61

[21] Krasnyuk, M., & Krasniuk, S. (2020). Comparative characteristics of machine learning for predicative financial modelling. *Збірник наукових праць ЛОГОΣ*, 55-57. https://doi.org/10.36074/26.06.2020.v1.21

[22] Краснюк, М. Т. (2014). Гібридна технологія ідентифікації нетрадиційних покладів вуглеводнів із застосуванням кластеризації та візуалізації даних для підвищення капіталізації вітчизняних нафтогазових компаній. *Європейські перспективи*, (4), 172-180.

[23] M. Krasnyuk, S. Goncharenko, S. (2022) Krasniuk M. Intelligent technologies in hybrid corporate DSS (on the example of Ukraine oil&gas production company) // *Інноваційно-інвестиційний механізм забезпечення конкурентоспроможності країни*: колективна монографія / за заг. ред. О. Л. Гальцової. – Львів-Торунь : Ліга-Прес, 2022. – С. 194-211.

[24] Krasnyuk, M., Hrashchenko, I., Goncharenko, S., Krasniuk, S. (2022) Hybrid application of decision trees, fuzzy logic and production rules for supporting investment decision making (on the example of an oil and gas producing company). *Access to science, business, innovation in digital economy*, ACCESS Press, 3(3): 278-291. DOI: https://doi.org/10.46656/access.2022.3.3(7)

[25] Гращенко І.С., Краснюк М.Т., Краснюк С.О. (2019) Гібридно-сценарне застосування інтелектуальних, орієнтованих на знання технологій, як важливий антикризовий інструмент логістичних компаній в Україні. *Вчені записки Таврійського Національного Університету імені В. І. Вернадського*. Серія: Економіка і управління. 2019. Том 30 (69). С. 121 – 129.

[26] Y. Kulynych, M. Krasnyuk and S. Krasniuk. (2022) Knowledge discovery and data mining of structured and unstructured business data: problems and prospects of implementation and adaptation in crisis conditions. *Grail of Science*, (12-13), 63–70. https://doi.org/10.36074/grail-of-science.29.04.2022.006

[27] Tuhaienko, V., & Krasniuk, S. (2022). Effective application of knowledge management in current crisis conditions. *Grail of Science*, (16), 348–358.

[28] Ситник В.Ф., Краснюк М.Т. "Політика управліня знаннями нафтогазової компанії як ключовий фактор підвищення її ефективності" (2002) *Проблеми формування ринкової економіки*: Міжвідомчий науковий збірник. Заснов. у 1992 р. Вип. 10 / Відп. ред. О.О. Беляєв. – К.:КНЕУ, 2002. – 326 с.

[29] Krasnyuk, M. T. (2006), "Problems of applying corporate knowledge management systems and their taxonomy", *Modeliuvannia ta informatsiini systemy v ekonomitsi*, vol. 73, p. 256

СЕКЦІЯ V. МЕНЕДЖМЕНТ, ПУБЛІЧНЕ УПРАВЛІННЯ ТА АДМІНІСТРУВАННЯ