Analyzing the Impact of Data Science Methods on Improving the Efficiency of Management Decisions

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Abstract. The purpose of this study is to analyze the impact of data science methods on the effectiveness of management decisions in the current conditions of dynamic change and uncertainty, particularly in the context of martial law in Ukraine. The paper investigates how modern analytical tools contribute to improving the accuracy of forecasts, optimizing resources, and speeding up decision-making. To achieve this goal, the following methods of scientific knowledge were used: literature analysis - to systematize knowledge about Data Science methods; system analysis - to identify relationships between components of management processes; data visualization - to present results in an understandable form. The study was conducted in three stages: preparatory - analysis of scientific sources and identification of key issues; analytical - evaluation of the effectiveness of Data Science methods in various fields (business, logistics, marketing, etc.); and final - formulation of recommendations and conclusions. The results obtained indicate a significant impact of Data Science methods on the efficiency of management processes. The use of predictive modeling can achieve forecast accuracy of up to 85%, and clustering algorithms can improve targeted marketing strategies, which helps to optimize costs. In logistics, data science helps reduce delivery times and improve supply chain management. In the context of martial law, these tools ensure adaptation to rapid changes in the external environment and efficient resource management. The findings of the study emphasize the importance of integrating data science methods into modern management processes, particularly in improving the accuracy of decisions, optimizing resources, and reducing risks. Further research can be aimed at a deeper analysis of adaptive Data Science models for crisis conditions, as well as at studying the ethical aspects of the use of analytical technologies. The development of Data Science tools can be a key factor in economic recovery after a crisis. The integration of these technologies will not only improve the efficiency of management decisions but also help to create sustainable business models for long-term development.

Keywords: data-based decision-making, management optimization, predictive modeling, efficiency improvement, algorithmic analysis.

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Introduction

Statement of the problem in general and its connection with important scientific or practical tasks. In the context of globalization and growing competition, organizations face the need to quickly adapt to changes in the external environment, such as market volatility, the introduction of innovative technologies, and changes in consumer behavior. The use of data science methods allows not only the improvement of forecast accuracy and the optimization of resources but also the creation of new approaches to risk management [1; 2].

The modern development of digital technologies, in particular Data Science methods, has led to significant changes in the management decision-making process. Organizations that use data as a basis for analysis and modeling achieve greater efficiency, adaptability to changes in the environment, and reduce the level of risks in the implementation of strategic objectives [3; 4].

However, despite the rapid growth in the number of Data Science tools and techniques, their implementation in management practice faces numerous challenges, such as insufficient staff training to work with analytical tools, limited access to quality and structured data, high level of uncertainty in forecasting, especially in the face of dynamic changes, as well as problems of integrating analytical results into current business processes and decision-making systems [5; 6; 7]. Therefore, the relevance of the study is due to the need to develop integrated approaches to the use of Data Science in management decision-making, especially in an environment of high uncertainty.

In the context of martial law in Ukraine, data science is critical to ensure effective resource management and decision-making in conditions of limited capacity and high uncertainty. Challenges faced by organizations in such conditions include the need for rapid risk assessment, forecasting economic stability, and coordinating logistics operations in real-time. Using Data Science methods, such as clustering algorithms, time series analysis, and predictive modeling, provides new opportunities to improve management efficiency even in a crisis. The study's relevance is also due to the need for a comprehensive analysis of the impact of data science on various aspects of management, including financial stability, socio-economic development, and strategic planning under uncertain conditions. This determines the need to develop approaches to integrating analytical methods into management systems to ensure the long-term sustainability of organizations.

Analysis of recent research and publications. The application of Data Science in management decision-making is actively studied, as evidenced by the following analysis of scientific sources. S. Prokopovych and co-authors [3] studied the use of Data Science methods to assess the economic development of regions, focusing on multivariate analysis. I. Radionova and Y. Fareniuk [8] studied the use of databases for management decisions under conditions of uncertainty at the macro- and microeconomic levels. However, these works need to sufficiently cover the issue of integrating the results of the analysis into management strategies.

I. Ponomarenko and I. Mykhailov [1] focused on the role of Data Science in business, while O. Chubukova and co-authors [4] focused on risk assessment methods. Both studies mainly describe specific approaches but do not consider their interaction with other management tools. V. Baranov [9] studied using artificial intelligence for risk management in projects, which opens up new opportunities in risk analysis but needs to cover the overall optimization of management decisions. The work of R. Pidlypnoi and co-authors [5] emphasized the effectiveness of statistical methods in financial management, but their application to strategic management still needs to be clarified.

B.B. Batiuk and I.V. Voronyi [2] analyzed innovative management decisions in modern conditions and Ya. I. Velychko and O. O. Hetman [10] studied the specifics of management decisions in logistics management. Both studies consider certain management aspects but ignore algorithmic analysis. I. Ponomarenko and O. Bytyk [11] considered the role of

recommender systems in marketing strategy, and O. Duma and M. Melnyk [12] highlighted modern market analysis technologies. Their works are valuable for understanding specific areas of data science application, but they need to reveal the potential for cross-sectoral implementation sufficiently.

O. Dehtiarova [13] studied the socio-economic aspects of using artificial intelligence, focusing on the risks and benefits, while S. Shamim and co-authors [14] analyzed the impact of big data management on the quality of decision-making. Both works ignore the practical aspects of integrating analytics into the decision-making process.

R. Hariri and co-authors [6] drew attention to the uncertainty in big data, while I. Sarker and co-authors [7] considered the prospects of Data Science in cybersecurity. F. Martínez-Plumed and co-authors [15] thoroughly reviewed the evolution of Data Science methodologies, but their conclusions remain primarily theoretical.

In general, existing studies cover various data science methods and their application. However, they must sufficiently cover integrating these methods into the overall management decision-making system. This necessitates further analysis of practical mechanisms for optimizing management based on Data Science.

This article aims to analyze the impact of Data Science methods on improving the efficiency of management decisions.

Objectives of the article:

1. Analyze the main Data Science methods used to analyze data in management.
2. To study examples of Data Science implementation in various management areas and evaluate their effectiveness.
3. Develop recommendations for integrating Data Science into management decisions.

Materials and methods

This study used a variety of methods of scientific knowledge, which were chosen to provide a comprehensive analysis of the impact of Data Science on the effectiveness of management decisions, in particular:

- literature analysis - used to study modern Data Science approaches and methods in scientific publications. This method allowed us to systematize the available knowledge and highlight the key aspects of the topic;
- system analysis - ensured the study of the relationships between the components of the management process optimized through the use of Data Science;
- data visualization - used to graphically represent the results obtained, contributing to a better understanding of the analytical findings.

The choice of these methods is based on their relevance to the research objectives and their ability to provide a systematic approach to analyzing the impact of Data Science. The literature analysis provided the theoretical basis for the study, the system analysis allowed to reveal the complex relationships between the elements of the management process, and the data visualization provided visibility of the results, simplifying their perception by managers.

The research was conducted in several stages. The first "Preparatory" stage included the study of scientific sources on Data Science methods and their implementation in the management field, as well as identifying the main problems and gaps in previous studies. The second "Analytical" stage involved analyzing the impact of data science methods on various areas (business, logistics, marketing, etc.). The last stage, the "Final" stage, involved the preparation of recommendations for integrating Data Science into management decision-making processes, as well as the formation of generalized research conclusions.

The chosen methods allow for a comprehensive approach to studying the impact of Data Science on management decisions. Analytical methods guarantee the thoroughness of the study, while modeling and visualization provide clarity and convenience for decision-making. The phased research allows us to gradually reveal all aspects of the topic and ensure the

scientific validity of the results. All stages of the study considered the specifics of modern governance, including the challenges associated with martial law in Ukraine.

Results

The development of Data Science methods has become a revolutionary phenomenon that has transformed approaches to management decision-making in modern organizations. In the context of global changes and high uncertainty caused by war, pandemics, and economic crises, organizations need innovative solutions to adapt to new realities. Data Science not only allows you to analyze large amounts of data but also provides support for decisions aimed at optimizing business processes, improving the accuracy of forecasts, and reducing risks.

Today, Data Science is used in a wide variety of industries, such as finance, logistics, marketing, public administration, and others. The results of the analysis show a significant impact of clustering, predictive modeling, and time series analysis on resource optimization and cost reduction. The uniqueness of these methods lies in their ability to adapt to rapid changes in the environment and create strategies that take into account a comprehensive analysis of many factors. Management decisions in the modern world are becoming increasingly dependent on the ability of organizations to analyze large amounts of data quickly and accurately. The use of Data Science methods allows not only to identify hidden patterns in data, but also to create predictive models that support strategic and tactical decision-making. In the context of globalization, the technological revolution, and increasing competition in the markets, the effective use of data is becoming a critical success factor for companies and organizations.

Research in this area demonstrates the significant potential of Data Science to optimize resources, reduce risks, and improve the efficiency of management processes. At the same time, the successful realization of these opportunities depends on the right choice of analysis methods, their adaptation to the specifics of the organization, and effective integration into existing business processes. Given the importance of this topic, we have analyzed the key Data Science methods that ensure the highest efficiency in management decisions and assessed their impact on achieving the strategic goals of organizations.

The key Data Science methods that ensure the effectiveness of data analysis in management decisions are shown in Table 1.

Table 1

Basic Data Science methods for data analysis in management

Data Science methods	Description.
Predictive modeling	This method is used to predict the results of management decisions by analyzing historical data and statistical models. For example, the use of predictive modeling can reduce decision-making time by 25% by automating analytical processes. In particular, regression and decision tree methods are often used to assess future scenarios and optimize business resources.
Clustering and segmentation	Cluster analysis methods allow you to group data by similar characteristics, which is key for targeted marketing and customer base management. Effective use of clustering helps increase productivity in companies that use it for customer segmentation.
Time series analysis	Time series analysis is widely used to identify trends and seasonality in data, which helps with sales planning, inventory management, and financial forecasting. The use of such methods provides a higher percentage of forecast accuracy, reducing the risk of making ineffective decisions.

Neural networks and machine learning algorithms	These methods help to identify complex dependencies in data and automate decision-making processes. For example, deep learning is used to analyze big data in real-time, which is critical in dynamic markets. Companies that have integrated machine learning into their processes achieve a 20-30% increase in efficiency in return on investment.
Data visualization	Visualization tools such as Power BI or Tableau allow managers to quickly analyze key performance indicators and make informed decisions. Visualization facilitates the communication of analysis results between different levels of management.

Sources: compiled by the author based on data from [10; 11; 16; 17].

Integration of Data Science methods into management processes opens up new opportunities for optimizing the work of organizations. In particular, using modern analytics tools allows automation of a significant part of data processing, significantly reducing the time spent on analysis and speeding up decision-making. This automation allows you to focus resources on strategically important tasks, minimizing delays associated with the human factor and increasing the speed of decision-making. In addition, the introduction of Data Science methods has a positive impact on the financial aspects of management. Reduced operating costs are achieved through more efficient resource allocation, supply chain optimization, and improved production process planning. For example, clustering and forecasting algorithms help identify unnecessary costs, reduce excess inventory, and improve customer service. In addition, using forecasting methods can significantly improve forecasts' accuracy, significantly reducing the risks of making strategic mistakes. This is made possible by an in-depth analysis of historical data and identifying hidden patterns not considered by traditional analysis methods. Using Data Science in crisis management ensures more efficient and effective management decision-making in the face of uncertainty caused by war, natural disasters, or economic crises. Time series analysis algorithms allow forecasting future development scenarios, considering the external environment's variability. For example, in the financial sector, using such algorithms helps reduce the risks associated with market volatility and changes in exchange rates. In the field of humanitarian logistics, Data Science is used to optimize the distribution of aid. Using analytical platforms such as Tableau or Power BI, it is possible to create interactive resource allocation maps, reducing delivery time in a crisis. This is especially true in martial law, where effective supply chain management is critical. Data Science tools are key in solving modern management problems by providing analytics, forecasting, and process automation. They allow organizations to work efficiently with large amounts of data, improving the accuracy of forecasts, accelerating decision-making, and personalizing customer experience. Below are the main Data Science tools and their tasks (see Figure 1).

It is worth noting that Tableau and Power BI are data visualization tools that allow you to create interactive graphs and dashboards quickly. They provide ease of use due to intuitive interfaces, which is especially valuable for managers who make data-driven decisions [18; 19]. TensorFlow and PyTorch are potent platforms for machine learning and predictive modeling. They allow the creation of adaptive models to accurately predict results and automate complex analytical processes [17; 19]. Apache Spark is a tool for processing large amounts of data that provides high speed and support for distributed computing and is indispensable for analyzing large amounts of information.

At the same time, Pandas is a Python library that allows you to efficiently process structured data, perform transformations, and analyze it. It is popular due to its ease of use and high performance [19]. DataRobot is a machine learning automation platform. It facilitates the creation of models, their testing, and integration into business processes, which reduces the time to implement solutions [17]. In addition, GitHub Copilot is used for project management to automate code writing using artificial intelligence.

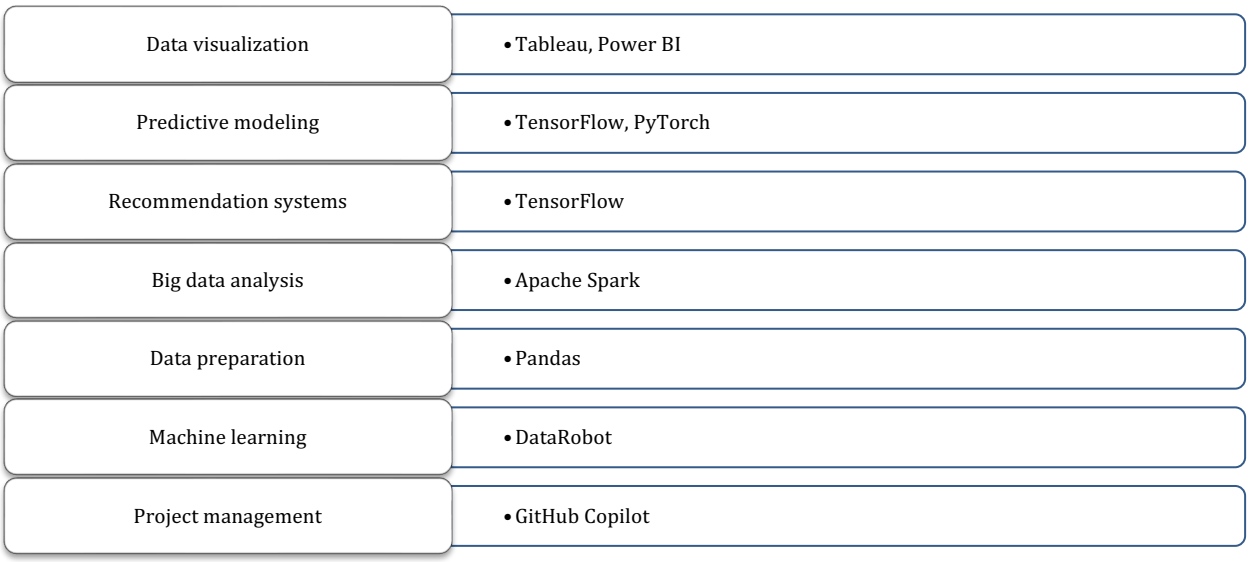

Fig. 1. Data Science tools for different tasks

Source: compiled by the author based on data from [17; 18; 19].

The use of Data Science methods significantly improves the efficiency of management decisions in various industries. In particular, the introduction of predictive modeling has allowed not only to optimize resource management but also to significantly improve the accuracy of management decision-making by taking into account a large amount of data. Clustering algorithms also help improve customer experience through targeted marketing strategies [1; 3]. In addition, neural networks automate management processes in a dynamic market environment, which allows for faster response to changes in external factors. This increases efficiency and accuracy in decision-making, especially in logistics management. In addition, the introduction of Data Science methods, in particular machine learning algorithms, contributes to a significant improvement in the accuracy of forecasts in various industries. According to a study [20], the accuracy of economic forecasts increases by 20-30% compared to traditional statistical approaches. This emphasizes the importance of integrating modern data analytics technologies to improve the efficiency of business processes.

A significant aspect of the study is to determine the impact of cluster analysis and predictive modeling methods on management decisions. In particular, the analysis showed that clustering methods are effectively used to identify groups of customers with similar characteristics, which contributes to a better understanding of their needs and optimization of marketing strategies. This approach allows tailoring offers to specific categories of customers, which is confirmed by studies of the implementation of recommendation systems [11]. Additionally, the introduction of predictive modeling algorithms helps to reduce risks in strategic decision-making by making it possible to assess future scenarios and their impact on the activities of organizations. In particular, the use of forecasting methods allows for predicting development trends and expected changes, which is critical for effective management under conditions of uncertainty. In addition, the use of economic and mathematical modeling in the process of developing solutions in analysis, audit, and taxation provides a systematic approach to risk assessment and informed management decisions [17].

In general, the effectiveness of Data Science methods is manifested in the ability of organizations to adapt more quickly to changes in the external environment, plan their resources better, and make more informed management decisions. These advantages make Data Science one of the most important tools for modern management. Integration of Data Science methods into various areas of management demonstrates numerous advantages,

contributing to improved decision accuracy, process optimization, and cost reduction. Table 2 shows examples of Data Science applications in business, marketing, logistics, and project management.

Table 2

Examples of Data Science implementation in various management areas

Management area	Data Science methods	Efficiency
Business	Clustering, time series analysis	Optimize business processes and improve customer service
Marketing	Recommendation systems	Increase the effectiveness of marketing campaigns through personalization
Logistics	Route optimization, big data analysis	Improve supply chain management and reduce costs
Project management	Scenario modeling, risk forecasting	Reducing risks and increasing project success

Sources: compiled by the author based on data from [10; 11; 16].

Data Science is used for customer segmentation and demand forecasting. Clustering allows you to identify key customer segments, which helps to optimize marketing strategies and increase customer satisfaction. Time series analysis helps to predict seasonal fluctuations in demand, which allows for more efficient production and inventory planning. Recommender systems help companies personalize offers for customers, increasing audience engagement and conversion of marketing campaigns. Using such systems allows us to understand the needs of consumers better and provide them with relevant offers. In logistics, Data Science methods, such as route optimization and big data analysis, help improve delivery efficiency and reduce costs. This allows companies to respond quickly to changes in demand and transportation conditions, optimizing the use of resources. Scenario modeling and risk forecasting are important tools in project management. Using data science allows for identifying potential risks early and ping strategies to avoid them, which increases project implementation success.

The introduction of Data Science in various areas of management demonstrates significant potential for improving organizational efficiency. Although specific numerical indicators may vary depending on the company and industry's specifics, the general trend shows a positive impact of Data Science methods on management processes.

Based on the analysis, Table 3 provides recommendations for effectively integrating Data Science methods into the management decision-making process.

Table 3

Recommendations for integrating Data Science into the practice of management decisions

The integration stage	Recommendations	Rationale
Preparatory stage	Professional development of employees	Insufficient knowledge of Data Science can be a barrier
Data infrastructure	Implementation of a high-quality data collection and storage system	Structured data ensures the accuracy of analytical models
Algorithmic analysis	Using predictive modeling and clustering	Improving the accuracy of forecasts and targeted decisions
Visualization of results	Integration of data analysis tools (Tableau, Power BI)	Facilitates decision-making based on clear visualizations
Evaluation of effectiveness	Regular monitoring and evaluation of implementation results	Allows you to quickly adjust the implementation strategy

Sources: author's development.

Analyzing Table 3, it is worth noting that at the initial stage of integration, it is necessary to train employees in the methods of working with Data Science. This may include conducting training, engaging experts, and creating internal training programs. Such measures will increase the level of awareness and preparation of staff to work with analytical tools.

The effectiveness of Data Science methods also depends on the quality of the data. It is recommended that integrated platforms for data collection, processing, and storage be created. This will ensure the availability and structured nature of data, which is critical for building accurate analytical models. The use of clustering and predictive modeling algorithms will allow organizations to better understand customers and predict future outcomes. For example, models based on machine learning can identify patterns in data and reduce the level of uncertainty in management decisions.

The integration of modern visualization tools such as Tableau or Power BI helps simplify the decision-making process. Visualization makes analytical data accessible and understandable to a wide range of users, including top management. Regular monitoring of the effectiveness of Data Science implementation will help identify weaknesses and make timely adjustments. The use of key performance indicators will help assess the impact of Data Science methods on management processes. Therefore, the recommendations are aimed at ensuring the effective implementation of Data Science in management processes, maximizing benefits, and minimizing risks.

In addition, the Data Scientist profession remains one of the most sought-after and highly paid in the world. Thanks to the development of data analysis and machine learning technologies, the demand for such specialists is steadily growing. They provide companies with a competitive advantage by interpreting large amounts of information to help make informed business decisions. In the United States, the average monthly income of a Data Scientist varies from $8,000 to $14,000, depending on qualifications, experience, and job specifics. In Europe, this figure ranges from €5,000 to €10,000. This confirms the high value and demand for the profession, even in the local context [18]. The relevance of this approach is confirmed by the need to quickly analyze large amounts of data to assess risks, predict development scenarios, and coordinate logistics processes. For example, in logistics, Data Science is used to optimize humanitarian aid delivery routes, which reduces delivery time in critical conditions. Platforms such as Tableau and Power BI provide visualization of data on resource allocation, allowing for faster decision-making.

In addition, in the financial sector, martial law has provoked an increase in the importance of risk assessment algorithms. The use of Data Science methods, such as time series analysis and predictive modeling, allows banks and financial institutions to effectively manage risks and ensure stability in difficult conditions. This includes forecasting currency fluctuations and identifying potential fraud threats.

The role of Data Science in monitoring socioeconomic indicators deserves special attention. Data analysis allows the government and international organizations to track the impact of martial law on key sectors of the economy, prioritize investments, and develop recovery strategies. Data Science is an indispensable tool in maintaining Ukraine's resilience under martial law. This underscores the importance of investing in developing relevant technologies and training specialists capable of working with such tools.

The study confirms that using Data Science methods in business processes can significantly improve their efficiency. One key result is an increase in forecasting accuracy. Using machine learning and time series analysis algorithms ensures forecast accuracy of up to 85% [16]. This is especially important in inventory management and logistics planning, where even a minor error can lead to financial losses.

Considerable attention is paid to cost optimization, particularly in marketing campaigns. Clustering to identify key customer groups helps to optimize marketing costs and increase the

effectiveness of targeted strategies. Personalizing offers through recommendation systems built on frameworks such as TensorFlow or PyTorch improves customer engagement. However, specific percentage performance indicators may vary depending on the specifics of the business and the implemented solutions [17].

Another important result is a reduction in decision-making time. The introduction of automated data analysis systems can significantly reduce the time required to process large amounts of information and draw conclusions. By using modern technologies such as machine learning and clustering algorithms, companies can respond more quickly to changes in market conditions and make informed decisions.

The research findings show that data science is a powerful tool for increasing companies' competitiveness. Integrating modern data analysis methods into the management decision-making process helps increase the accuracy of forecasts and reduce costs. It improves the overall business efficiency in a rapidly changing environment. This emphasizes the feasibility and necessity of implementing Data Science as a strategic resource for the development of organizations.

Conclusions

The study confirmed the relevance of using Data Science as a key tool for solving modern management challenges, especially in the context of uncertainty caused by martial law in Ukraine. The study achieved its goal of determining the impact of Data Science technologies on the efficiency of management decisions, resource optimization, and business adaptation to crisis conditions. All the research objectives set at the beginning of the study have been fulfilled.

In particular, predictive modeling, time series analysis, and clustering algorithms can significantly improve forecast accuracy, reduce decision-making time, and optimize costs. These tools also play an important role in crises, such as martial law, ensuring effective management of logistics operations, distribution of humanitarian aid, and monitoring of socioeconomic indicators.

The study confirmed that Data Science can serve as a basis for developing long-term development strategies for organizations, reducing the impact of risks and ensuring their sustainability in changing conditions. At the same time, it was determined that to maximize the effectiveness of implementing these technologies, it is necessary to ensure access to quality data and invest in the development of analytical tools and staff training.

Prospects for further research in this area include:

- a deeper analysis of the application of Data Science in various sectors of the Ukrainian economy in the context of post-war recovery;
- developing adaptive models for big data analysis that take into account the specifics of crises;
- studying the ethical aspects of Data Science application in public administration and business, in particular in the context of restrictions on access to information;
- studying the impact of artificial intelligence and machine learning technologies on the automation of management decisions.

In general, the study's results demonstrate the great potential of Data Science as a means of transforming management processes, especially in times of crisis. This area remains open for further research and improvement of methods to ensure more sustainable and efficient organizational development.

List of references

1. Ponomarenko, I. V., & Mykhailov, I. O. (2021). Features of using Data Science in business [Features of using Data Science in business]. *Infrastruktura rynku - Market Infrastructure, 60*, 232-235. Retrieved from http://market-infr.od.ua/journals/2021/60_2021/42.pdf

2. Batiuk, B. B., & Voronii, I. V. (2016). Teoriia pryiniattia upravlinskikh rishen v menedzhmenti pidpryiemstva ta yikh klasifikatsii [Theory of managerial decision-making in enterprise management and their classification]. *Scientific Visnyk of Lviv National University of Veterinary Medicine and Biotechnology named after S. Z. Gzhytskoho - Scientific Bulletin of Lviv National University of Veterinary Medicine and Biotechnologies named after S. Z. Gzhytskyi, 18*(2(69)), 3-8. https://doi.org/10.15421/nvlvet6901

3. Prokopovych, S. V., Chahovets, L. O., & Kholod, V. A. (2020). Application of Data Science methods in the comprehensive evaluation of regional economic development [Application of Data Science methods in the comprehensive evaluation of regional economic development]. *Upravlinnia rozvytkom - Development Management, 3*, 43-56. Retrieved from http://repository.hneu.edu.ua/bitstream/123456789/25471/1/%d0%a7%d0%b0%d0%b3%d0%be%d0%b2%d0%b5%d1%86%d1%8c%201.pdf

4. Chubukova, O. Yu., Ponomarenko, I. V., & Domantovych, O. P. (2020). Using Data Science for risk assessment [Using Data Science for risk assessment]. *Infrastruktura rynku - Market Infrastructure, 47*, 129-132. Retrieved from https://er.knutd.edu.ua/bitstream/123456789/17658/1/26.pdf

5. Parfentseva, N. O., & Holubova, H. V. (2022). Modeliuvannia finansovykh ryzykiv na osnovi statisticheskikh metodiv otsiniuvannia [Modeling financial risks based on statistical evaluation methods]. *Scientific Bulletin of the National Academy of Statistics, Accounting, and Auditing, 1-2*, 14-20. https://doi.org/10.31767/nasoa.1-2-2022.02

6. Hariri, R. H., Fredericks, E. M., & Bowers, K. M. (2019). Uncertainty in big data analytics: Survey, opportunities, and challenges. *Journal of Big Data, 6*(1), 1-16. Retrieved from https://link.springer.com/article/10.1186/s40537-019-0206-3

7. Sarker, I. H., Kayes, A. S. M., Badsha, S., Alqahtani, H., Watters, P., & Ng, A. (2020). Cybersecurity data science: An overview from machine learning perspective. *Journal of Big Data, 7*, 1-29. Retrieved from https://link.springer.com/article/10.1186/s40537-020-00318-5

8. Radionova, I. F., & Farenyuk, Ya. V. (2021). Analiz na osnovi baz danykh (Data Science) dlia upravlinskykh rishen z urakhuvanniam nevyznachenosti makro- ta mikroekonomichnoho rivniv [Database-based analysis (Data Science) for managerial decisions considering uncertainty at macro and microeconomic levels]. *Economics of Uncertainty: Content, Assessment, Regulation*, 99-121. Retrieved from https://library.krok.edu.ua/media/library/category/monografiji/radionova_0013.pdf#page=99

9. Baranov, V. (2021). Rol shtuchnoho intelektu v upravlinni proiektamy [The role of artificial intelligence in project management]. In Ye. H. Kartashov & O. V. Dubinina (Eds.), *Ekonomichni, sotsialni ta informatsiini mekhanizmy formuvannia ta vdoskonalennia systemy upravlinnia proiektamy - Economic, Social, and Informational Mechanisms of Project Management Formation and Improvement* (pp. 302-317). Kyiv: NAPN Ukrainy DZVO "Un-t menedzh. osvity".

10. Velychko, Ya. I., & Hetman, O. O. (2023). Formuvannia upravlinskoho rishennia shchodo vyboru lohistychnoi stratehii pidpryiemstva [Forming a managerial decision on choosing a company's logistics strategy]. *Ekonomika transportnogo kompleksu [Economy of Transport Complex], 42*, 221-246.

11. Ponomarenko, I. V., & Bytyk, O. B. (2021). Using recommendation systems for optimizing a company's marketing strategy [Using recommendation systems for optimizing a company's marketing strategy]. *Entrepreneurship and Innovation, 19*, 34-39.

12. Duma, O. I., & Melnyk, M. S. (2021). New technologies in marketing research and market analysis [New technologies in marketing research and market analysis]. *Menedzhment ta pidpryiemnytstvo v Ukraini: etapy stanovlennia ta problemy rozvytku [Management and Entrepreneurship in Ukraine: Stages of Formation and Development, 2*(6), 29-39.

13. Dehtiarova, O. O. (2023). Sotsialno-ekonomichni aspekty zastosuvannia shtuchnoho intelektu v biznes-seredovyshchi [Socio-economic aspects of using artificial intelligence in the business environment]: Perevahy ta ryzyky [Socio-economic aspects of using artificial intelligence in the business environment: Advantages and risks]. *Visnyk sotsialno-ekonomichnykh doslidzhen - Bulletin of Socio-Economic Research, 1-2*, 84-85.

14. Shamim, S., Zeng, J., Shariq, S. M., & Khan, Z. (2019). Role of big data management in enhancing big data decision-making capability and quality among Chinese firms: A dynamic capabilities view. *Information & Management, 56*(6), 103135.

15. Martínez-Plumed, F., Contreras-Ochando, L., Ferri, C., Hernández-Orallo, J., Kull, M., Lachiche, N., & Flach, P. (2019). CRISP-DM twenty years later: From data mining processes to data science trajectories. *IEEE Transactions on Knowledge and Data Engineering, 33*(8), 3048-3061.

16. Netreba, M. M., Shibirina, S. O., & Korolenko, O. B. (2022). Digital-menedzhment yak mehanizm efektyvnosti biznesovykh struktur [Digital management as a mechanism for the efficiency of business structures]. *Scientific Perspectives, 5*(23), 246-258.

17. Becker, T., Metzger, D., Selz, D., & Eser, A. (2020). Data Science und AI. Digitale Welt, 4(3), 52–58. https://doi.org/10.1007/s42354-020-0283-7

18. Khto takyi data scientist ta yogo rol u komandi [Who is a data scientist and their role in a team]. *Eastern Peak - Work in an International IT Company [Eastern Peak - Work in an International IT Company]*. Retrieved from https://careers.easternpeak.com/blog/the-role-of-data-scientist-in-a-team/ (accessed February 10, 2023).

19. Runkler, T. A. (2020). *Data Analytics*. Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-29779-4 (accessed February 10, 2023).

20. Perflieva, A., Siliutina, I., Antypenko, N., & Vlasenko, D. (2022). Digital economy as a factor of economic development of the state. *Financial and Credit Activity Problems of Theory and Practice, 6*(41), 329-338. https://doi.org/10.18371/fcaptp.v6i41.251465