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ORIGINAL

The role of big data in ensuring transparency and accountability of public authorities

El papel de los macrodatos para garantizar la transparencia y la rendición de cuentas de los poderes públicos

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ABSTRACT

The study is aimed at highlighting the theoretical and practical aspects of the use of big data in the public administration system on the example of Ukraine. The study used various works of scientists dedicated to the study of the peculiarities of using big data in the public administration system. The results of global rankings (Open Data Barometer; Global Government Forum) and data from the information and analytical agency Statista were also used. Economic and statistical analysis methods were used to achieve the research objective. These methods helped to determine the volume of global big data market revenue since 2011 with a forecast for 2025-2027, the share of global big data market revenue since 2013 with a forecast for 2025-2027 by major segments, and Ukraine's rating of open data development in 2015-2017. The methods of schematic and graphical display of data were also used to visualize the theoretical and practical foundations of the study. The method of logical generalization of the results was used to formulate conclusions. Moreover, the methods of systematization and comparison, induction and deduction were used. The study outlined the main opportunities for using big data in public administration. This includes accelerating and improving management processes, increasing transparency, reducing costs, and promoting the development of platforms for analyzing public finances, public procurement, and other important areas.

Keywords: Artificial Intelligence; Blockchain Technologies; Digital Processes; Open Data; Public Administration.

RESUMEN

El estudio tiene como objetivo poner de relieve los aspectos teóricos y prácticos del uso de big data en el sistema de administración pública tomando como ejemplo Ucrania. Para el estudio se han utilizado diversos trabajos de científicos dedicados al estudio de las peculiaridades del uso de big data en el sistema de administración pública. También se utilizaron los resultados de rankings mundiales (Open Data Barometer; Global Government Forum) y datos de la agencia de información y análisis Statista. Para alcanzar el objetivo de la investigación se utilizaron métodos de análisis económico y estadístico. Estos métodos ayudaron a determinar el volumen de ingresos del mercado mundial de big data desde 2011 con una previsión para 2025-2027, la cuota de ingresos del mercado mundial de big data desde 2013 con una previsión para 2025-2027 por segmentos principales, y la calificación del desarrollo de datos abiertos de Ucrania en 2015-2017. También se utilizaron los métodos de representación esquemática y gráfica de los datos para visualizar los fundamentos teóricos y prácticos del estudio. El método de generalización lógica de los resultados se utilizó para formular conclusiones. Además, se utilizaron los métodos de sistematización y comparación, inducción y deducción. El estudio esbozó las principales oportunidades que ofrece el uso de big data en la administración pública. Entre ellas, la aceleración y mejora de los procesos de gestión, el aumento de la transparencia, la reducción

de costes y la promoción del desarrollo de plataformas de análisis de las finanzas públicas, la contratación pública y otras áreas importantes.

Palabras clave: Inteligencia Artificial; Tecnologías Blockchain; Procesos Digitales; Datos Abiertos; Administración Pública.

INTRODUCTION

The use of big data is becoming increasingly important for both the private sector and public administration. The analysis of big data in business opens up opportunities to reduce costs, improve customer experience, and increase profits. Similar opportunities can also be effectively used by government agencies, regional authorities, and local communities to improve the efficiency of public administration.[1,2] This is especially relevant in the context of the ongoing digitalization of society, when automation of processes based on big data can contribute to better decision-making and transparency.[3]

A new aspect in this context is the use of artificial intelligence to analyze big data, which allows processing huge amounts of information in real time and identifying hidden patterns.[4] Also, with the development of the smart cities concept, big data plays a crucial role in implementing innovative solutions for managing urban infrastructure, transportation, and the environment.[5]

An analysis of the scientific literature on the use of big data in public administration has revealed a number of main areas and gaps in research. An important problem is the lack of attention to big data management and its impact on the effectiveness of decision-making in the public sector.[6,7] Studies have shown that digital transformation and the introduction of big data analysis technologies have the potential to significantly improve the efficiency of public administration.[8,9]

The authors analyzed specific aspects of big data application, but did not focus on the specifics of integrating these technologies into public policy at all levels. A research article examined the opportunities and challenges of implementing big data in the context of specific regions or industries.[10,11] A study demonstrated opportunities for improving the efficiency of governance through the use of data, but the issues of coordination between different government departments remain open.[12,13] Thus, despite the large number of studies on the chosen topic, the study of big data in the field of public administration requires modernization and additional research.[14]

The purpose of the study is to theoretically and practically highlight the peculiarities of using big data in the public administration system on the example of Ukraine. The following objectives were set during the study to achieve this goal:

1. To identify general trends in the use of big data in the world.
2. To outline the possibilities of using big data in public administration.
3. To analyze the experience of using big data in public administration in Ukraine.

METHOD

The current study has collected and analyzed data on the global big data market revenues since 2011 and made forecasts for the periods 2025-2027. Also analyzed are the shares of global big data market revenue by major segments since 2013 with forecasts for the same years. The main sources of information were analytical resources, such as Statista (2024), Global Government Forum (2024) The collected data were structured and systematized for economic and statistical analysis.

The next stage of the study included thematic reviews that highlighted the main opportunities and areas for implementing big data in the public sector. The main benefits included improved efficiency of management processes, increased transparency, and reduced costs. The findings were systematized into categories of opportunities, which allowed for a clear structure for further analysis within the study.

The next step was to analyze the use of big data in public administration on the example of Ukraine. For this purpose, official international reports, specialized sources, and practical examples of big data implementation in the country were studied (Open Data Barometer, 2017; Samokhodskyi, 2023). To analyze the experience of using big data in public administration in Ukraine, the open data platforms and e-government platforms, in particular ProZorro and e-Data, were studied.

The study covered the period before the war, when Ukraine was a leader in open data implementation, and focused on successes in areas such as public procurement, public finance, and environmental monitoring. The analysis also took into account the restrictions caused by the war and the current requirements to restore access to data to ensure transparency and efficiency of management processes. The study takes into account the regulation established by the GDPR, a European Union regulation that, as of May 25, 2018, governs the collection, processing, and storage of personal data of EU and European Economic Area citizens.

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RESULTS

Overview of current trends in the use of big data

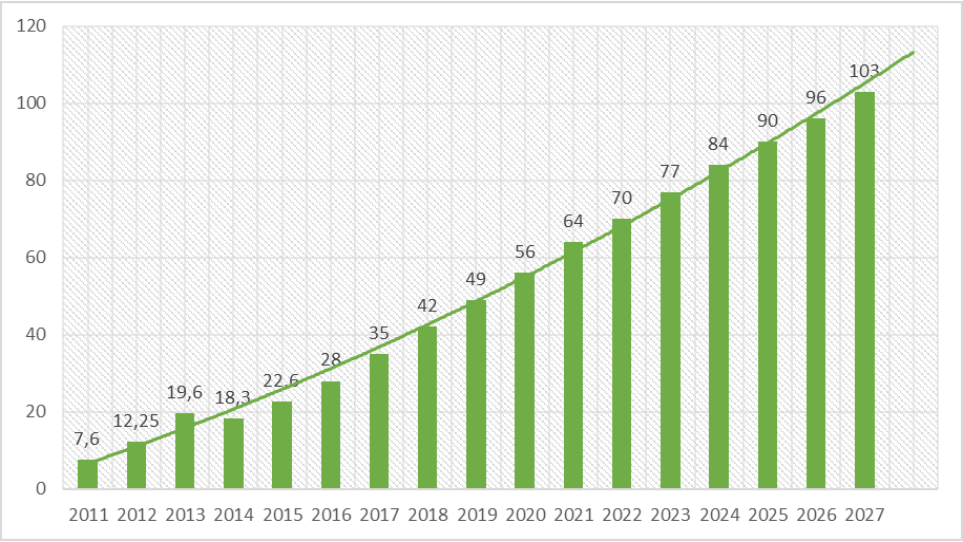
The Internet has radically changed social and economic life today, opening up new perspectives for information and technology. Advances in data creation and processing technologies have made the processes of collecting, storing and analyzing large amounts of information much easier and more accessible. The Internet has made the dissemination of big data much easier and faster, providing fast and unhindered access to data.

Information used to be a limited resource available only to individual companies or government agencies. In 2024, humanity is dealing with huge amounts of data that open up new opportunities and prospects. Since the early 1990s, governments have been actively using collected data for practical, legal, and administrative purposes. At the beginning of the 21st century, websites, online portals, social networks, and blogs became so widespread that public authorities were able to effectively use information from open sources to make informed decisions.

The famous German economist Schwab (2017) described the present as the fourth technological revolution. The era of digital innovation that has opened up great opportunities. The author emphasized that technological changes will affect not only the economy, business, and society, but also the state system as a whole. Data plays an important role in the process of policy development, implementation, and monitoring. Using the latest advances in generative artificial intelligence, organizations can create different policy strategies and options. Advanced analytical methods allow to identify patterns and correlations in data, as well as to predict trends.

Big data allows to assess the possible consequences of various policy decisions, identify problems and evaluate the effectiveness of proposed interventions. Big data is defined as large and complex data sets that cannot be efficiently processed by traditional processing methods due to their enormous volume, diversity, and speed of generation.

The Oxford Dictionary defines big data as a term that describes large amounts of data that are beyond the capabilities of conventional data processing applications due to their volume, the variety of data types, and the speed at which the data is created and must be processed. Managing such data requires specialized technologies and tools to analyze and process it, as traditional systems cannot cope with the volume and complexity of information. The popularity and widespread use of big data in the world is confirmed by the data of the analytical company Statista (figure 1), according to which the revenue of the big data market in the world should reach 103 million USD in 2027.



Source: Statista[14]

Figure 1. Revenues of the big data market in the world since 2011 with a forecast for 2025-2027, USD million

Figure 1 illustrates that the global big data market has shown steady growth since 2011, gaining momentum in recent years. The market has increased from USD 7,6 million in 2011 to USD 70 million in 2023, indicating growing interest and increased investment in this area. Figure 2 shows the structure and dynamics of the global big data market revenue share since 2013, including forecasts for 2025-2027 by key segments: services, hardware, and software.

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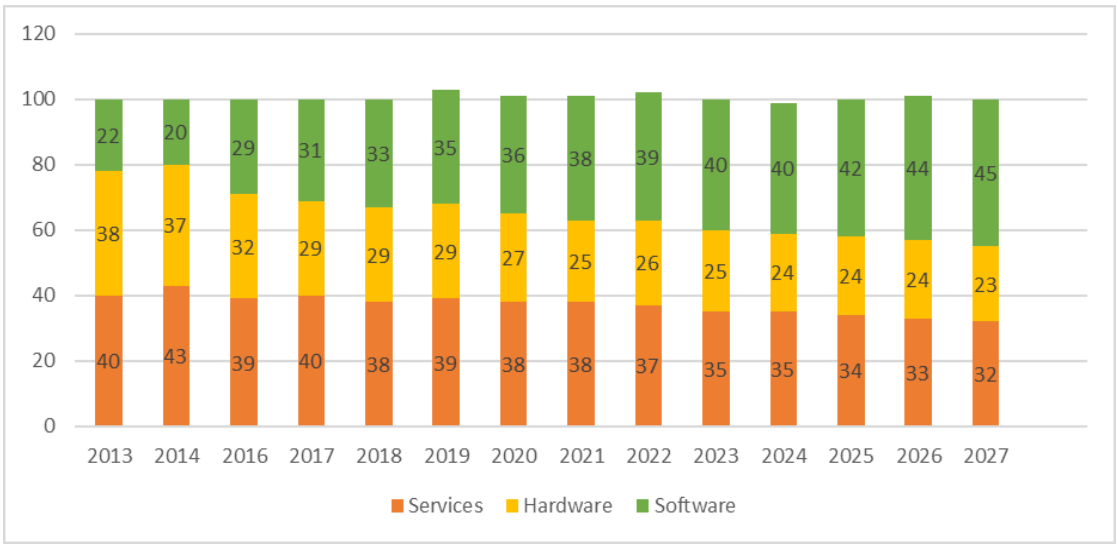


Source: Statista[15]

Figure 2. Global big data market revenue share since 2013 with forecast for 2025-2027 by major segments, %

This means that during the analyzed period, there was a clear change in the balance between different segments of the big data market. Services and hardware are gradually losing ground, but software is steadily strengthening its position, becoming the main area of development. This trend indicates the growing role of technological solutions that provide innovations and increased efficiency in working with big data, especially in the context of digital transformation and the development of intelligent systems.

Big data opportunities for public administration

Public administration improvement with the help of the latest technologies is one of the most relevant topics. The most effective technologies that can increase the efficiency of public organizations and generally improve the level of public administration include big data, artificial intelligence, and blockchain. The scope of big data application is extremely broad, and its collection and analysis is a challenge for public organizations. Since working with big data requires the use of powerful computers, it also requires the involvement of specialists of a certain profile to analyze and draw conclusions based on the collected data.

The role of big data can be observed in various areas of its use, including policy-making based on the ability to quickly collect large amounts of information from many sources, such as social media, official government websites, and group chats, which in turn helps to increase the accuracy, efficiency, and speed of the governance process, and assists in predicting both policy steps and the circumstances under which they can be implemented.

This allows for the development of policies that best meet stakeholder expectations. The Commonwealth Scientific and Industrial Research Organization, for example, uses big data to analyze information posted by citizens on social media. The data is used to control the spread of fake news. The organization also conducts a detailed assessment of the activities of companies participating in public tenders. As a result, the most suitable candidates are selected based not only on the cost of services but also on other important factors.

In terms of policy implementation, big data provides an opportunity to increase the efficiency of public organizations by identifying excess costs and eliminating them, while optimizing the allocation of resources in real time, which allows not only to improve the delivery of public services but also to personalize services for users. Moreover, the use of big data provides opportunities to create new services that were not previously considered, allows for more effective control over policy implementation by identifying anomalies in large amounts of information, for example, in monitoring activities that require a license, improving public safety in smart cities, and automatically optimizing services to ensure efficient delivery.

In the area of policy research and evaluation, big data facilitates a deeper analysis of existing initiatives and the identification of reform areas, providing insight into the long-term effects of certain policies and the ability to predict the effectiveness of alternative management models and organizational changes. The use of big data to analyze financial transactions in public transportation can optimize routes, reduce unemployment fines, prevent crime, and explore the relationship between building types and crime rates.

Big data promotes the development of new models of public governance that take into account the growing need for partnerships between governments and active citizens, helping to create data-driven and actionable governance methods. It also contributes to increasing the transparency of the public sector through evidence-based decision-making and long-term effects, as in the case of smart governance models that actively use data.

In the UK, big data is actively used to fight fraud in the public sector. Since 2021, the Public Sector Fraud Authority has been using analytics and data to detect and prevent financial abuse. This enables the authority to

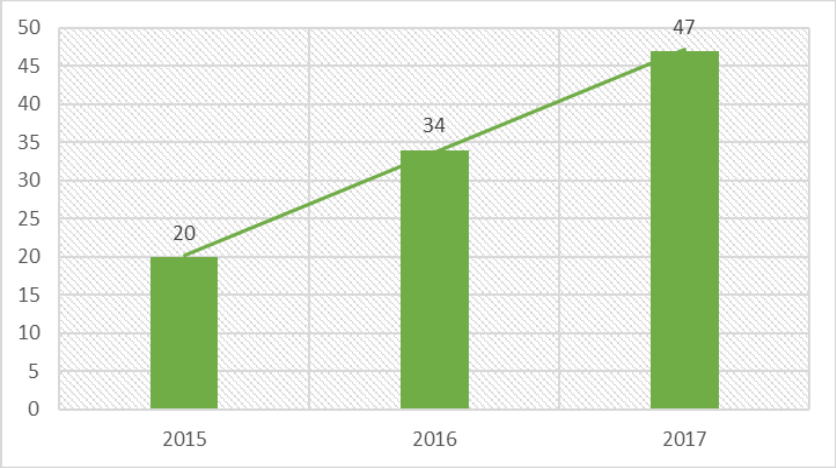
prioritize risky areas where the possibility of fraud is high and to develop effective strategies to recover funds spent by taxpayers. New analytical tools were introduced in 2022 to identify and prevent dozens of cases of misuse of public funds. These examples demonstrate how big data contributes to improving transparency and accountability in the use of public finances.

The use of big data in public administration offers many benefits, but also carries certain risks. The main risk is the protection of citizens' privacy. The collection and analysis of large amounts of personal data can lead to a breach of privacy if the data is not properly protected. For example, in some cases, when government agencies analyze data from social media or medical records, there is a risk that this data could be used for unauthorized surveillance or even manipulation. The potential misuse of information is another risk that needs to be considered.

In May 2018, the UK faced serious problems related to the use of algorithms and data management in the public sector. The Minister of Health blamed a computer algorithm for errors in cancer screening, the South Wales Police admitted that their facial recognition system produced thousands of false positives, and Amnesty International criticized the Metropolitan Police database for racial discrimination. Cambridge Analytica was forced to shut down its operations after being subjected to legal pressure for misusing Facebook data. These facts vividly demonstrate the risks of algorithmic data management in public institutions.

Features of the use of big data in public administration in Ukraine and recommendations for further improvement

Ukraine was one of the leading countries in Europe in implementing open data policies before the war. It was actively implementing relevant laws, following the principle of "open by design and by default" even before the adoption of the relevant EU directive. Ukraine received 47 points in 2017 (figure 3) and was ranked 17th among 30 countries that have committed to the principles of the Open Data Charter. Regrettably, no further rankings have been formed.



Source: Open Data Barometer[6]

Figure 3. Ranking of Ukraine in terms of open data development in 2015-2017, points

The ProZorro system made almost all public procurement data accessible. The e-Data platform provided open access to information on public finances. Additionally, a unified state register (USR) was created, and financial statements along with other key data sets were published in an open data format. This progress in the implementation of open data has contributed to the development of numerous platforms for verifying individuals, analyzing public procurement, searching for court decisions, and monitoring the state of the environment in Ukraine, such as Diia, Privat24, eGov, Electronic Citizen's Cabinet, Online House of Justice, Single Window Web Portal, etc.

These services were very popular, attracting 5 to 7 million users annually, according to statistics from 2021. Ukraine's digital e-governance platforms based on open data have been internationally recognized as some of the best digital solutions in the world. In the construction industry, which will play a major role in rebuilding Ukraine after the war, open data from the State Architectural and Construction Inspectorate has contributed to improved control and transparency in construction.

The access to data was significantly restricted with the outbreak of the war which led to the loss of Ukraine's leadership position in this area. The Open Data Portal was initially completely blocked, but later partial access to some datasets was restored. The process of returning to full access continues to this day. During the war and martial law, Ukrainian civil society organizations have been actively appealing to the government to resume

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publication of key datasets. The RISE Ukraine coalition has compiled a list of priority data needed to ensure a transparent process of recovery.

Open data remains an important tool for preventing corruption, improving the efficiency of government processes, and building trust in the allocation of budget funds even during the war. The risk exists that Russia could use some data to improve the effectiveness of its military operations, especially in the temporarily occupied territories, including personal data, as well as information about infrastructure and businesses. Ukraine needs to strike a balance between openness and security, which is a difficult task that requires a cautious approach. At the same time, excessive restriction of access to data is not the optimal option, particularly in times of war.

Ukraine needs to focus on implementing technologies to obtain real-time data, which will allow government agencies to respond more quickly to changes in the situation, increasing the efficiency of service to citizens and improving their experience of interacting with government agencies.

It is necessary to focus on the creation and management of data as products, which involves the development and implementation of new data pipelines that will ensure efficient data collection, processing, and use. It is important to integrate new approaches to collaboration and data exchange between different organizations to optimize processes and achieve strategic goals. Implementation of such practices will reduce data duplication and improve data quality. Data pipelines are processes that organize the path that data takes from the moment it is collected to the time it is available for use. It can be imagined as a conveyor belt, where raw materials (data) enter at the beginning and at the end the finished product is clean, processed data that is ready for analysis or decision-making. This process helps to avoid errors, maintain order, and ensure the speed of data processing.

The Government of Ukraine strives for compliance with modern rules and requirements, so government programs, strategies, and concepts are being actively developed and implemented at the national level. The Concept for the Development of E-Governance in Ukraine emphasizes that citizens' lives are becoming increasingly digital. This creates high expectations for the activities of public administration and local self-government bodies, which should ensure the development of modern electronic tools for interaction, transparency and openness in their work, as well as active involvement of citizens in decision-making. Further development of e-governance in Ukraine can be carried out in two directions: conservative or transformational.

The transformation path is a revolutionary approach that aims to enhance the functionality of e-government and reduce the costs of government authorities in the exercise of their powers through the introduction of modern innovative technologies, methodologies and approaches. These technologies include the Internet of Things, cloud infrastructure, Blockchain, Mobile ID, sharing economy, and the promotion of methods of working with large amounts of data. The emphasis is also placed on regulating the principles of "digital by default", "one-time information entry" and "interoperability by default". An important component of this approach is the use of modern forms of organizing tasks and implementing e-government projects, including public-private partnerships.

DISCUSSION

The use of big data in public administration and local government has significant advantages and prospects. It helps to identify hidden patterns that are not always visible using traditional methods, opening up new opportunities for optimizing various areas of social and economic life: from public and municipal administration to healthcare, security, finance, transportation, and education. The same opinion is shared by Dziundziuk[3], Tverdokhlib et al.[16], who also noted that the use of big data in public administration can increase the level of data protection. The combination with artificial intelligence and blockchain can transform unprocessed data into useful information.[17]

The results obtained in the current study emphasize the importance of integrating modern big data technologies to increase the efficiency, transparency, and flexibility of public administration in Ukraine.[18] These findings are in line with those of other authors Yakovlev et al.[19], who also emphasize that big data provides an opportunity to analyze large amounts of information, identify new correlations, and gain valuable knowledge that would not be available without these technologies.

Yakovlev et al.[19] study pay considerable attention to the legal aspects and risks of using big data, including privacy, human rights protection, and the risk of excessive state interference in private life, which was not the subject of this study.

The results of the study by Rakšnys et al.[9] present the concept of using big data and artificial intelligence technologies in public administration and social policy in the context of the products of the fourth industrial revolution. They emphasize the wide possibilities of using big data for analyzing, modeling, and forecasting phenomena related to public administration.

The authors distinguish three main types of big data: historical, relevant (with minimal delay), and predictive. The current study also highlights such benefits of using big data in public administration as personalization opportunities, improving the quality of public services, reducing data processing costs, more

accurate forecasting, increasing citizen satisfaction and involvement in management processes. Both studies emphasize the promise of using big data in public administration to increase the objectivity of decision-making, fight corruption, and improve public trust in government institutions. Nevertheless, there is still a clear need to develop strategies to address barriers such as data fragmentation, lack of cooperation, and lack of competencies in the public sector.[20]

Pencheva et al.[8] state that these technologies have the potential to have a significant impact on governments around the world, providing new opportunities to optimize decision-making processes and improve the effectiveness of public policy. It should also be noted that there are data security issues, imperfect regulatory frameworks, limited technical resources and competencies, and ethical issues related to the use of big data in the public sector. The current study also focuses on this issue. The key difference is that Pencheva et al.[8] suggest future research directions, including exploring methods to increase the value of big data for practitioners and addressing ethical issues. This complements the current study, which focuses on the practical implementation of big data and solutions to local challenges.

CONCLUSIONS

Summarizing the findings of the current study, it can be emphasized that the benefits of using big data in public administration and local self-government are undeniable. It allows identifying hidden patterns that remain beyond human perception. This opens up great opportunities for optimizing various areas of public life, such as state and municipal administration, medicine, security, finance, transportation, education, etc.

The study found that these technologies have become an integral part of optimizing business processes, forecasting trends, and making data-driven decisions. The use of artificial intelligence, machine learning, cloud technologies, and blockchain has made the analysis and use of large amounts of information more efficient, allowing not only to solve current problems but also to anticipate future challenges.

The implementation of big data in public administration in Ukraine is currently at the stage of gradual and slow development. There are certainly successful practical examples, including open data platforms, e-government systems, and analytical tools for management in various sectors. This allows not only to increase the transparency of government agencies, but also to automate administrative processes, improving the efficiency of management decisions.

Ukraine needs to expand its existing legislation, improve technical capabilities, and increase the digital literacy of public sector employees despite certain achievements. These conditions are the only way for big data to realize its full potential and contribute to the further development of public administration in Ukraine.

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Data curation: Herasym Dei.
Methodology: Herasym Dei.
Software: Herasym Dei.
Drafting - original draft: Herasym Dei.
Writing - proofreading and editing: Herasym Dei.