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THE ROLE OF BIG DATA IN FORECASTING THE FINANCIAL RESULTS OF AN ENTERPRISE

Seisebaeva N.G., Proskurina N.M., Udodova Ya.V., Konyk. Y.R.
Zaporizhzhia National University
Ukraine, 69011, Zaporizhzhia, Universytetska str., 66
ngs19570104@gmail.com, profauditzp@ukr.net, yana–vadimovna@ukr.net
ORCID: 0000-0002-6496-2554, 0000-0001-8674-1720, 0009-0000-5922-8016

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In today's dynamic economic environment, enterprises face increasing challenges in terms of effective financial management, risk assessment and strategic decision-making. In the face of constant market changes, price fluctuations, global competition and unstable external factors, the ability of a business to quickly and accurately forecast its financial results plays a key role. Traditional financial analysis tools, which are based on historical reports and linear models, are increasingly proving insufficient to fully take into account all the variables that affect the financial stability of the enterprise. In this context, innovative approaches, in particular the use of Big Data processing technologies, come to the fore.

Big Data is not only huge amounts of digital information, but also a new way of thinking in financial management. Thanks to modern information systems, enterprises can collect, process and analyze data from dozens of sources: transactional systems, CRM platforms, social networks, Internet resources, sensors, etc. All this allows you to detect hidden patterns, model future financial flows, quickly identify risks and predict the effectiveness of management decisions. It is analytics based on Big Data that provides a new quality of decision-making, more accurate, more adaptive and one that takes into account the multifactorial reality of modern business.

The value of Big Data in financial forecasting also lies in the ability to provide up-to-date, relevant and personalized data for different divisions of the enterprise. This allows you to integrate financial analytics with production, marketing and logistics processes, forming a single information and analytical platform for management. The use of big data not only improves the accuracy of forecasts, but also optimizes budget planning, increases investment efficiency, allows you to minimize costs and avoid financial losses in the future.

РОЛЬ ВЕЛИКИХ ДАНИХ В ПРОГНОЗУВАННІ ФІНАНСОВИХ РЕЗУЛЬТАТІВ ПІДПРИЄМСТВА

Сейсебаєва Н.Г., Проскуріна Н.М., Удодова Я.В., Коник Є.Р.
Запорізький національний університет
Україна, 69011, м. Запоріжжя, вул. Університетська, 66

Ключові слова:
великі дані (Big Data). інноваційні технології, інформаційні системи, фінансове прогнозування, інтеграція.

Big Data – це не лише величезні масиви цифрової інформації, а й новий спосіб мислення у фінансовому менеджменті. Завдяки сучасним інформаційним системам, підприємства можуть збирати, обробляти й аналізувати дані з десятків джерел: транзакційних систем, CRM-платформ, соціальних мереж, інтернет-ресурсів, сенсорів тощо. Усе це дозволяє виявляти приховані закономірності, моделювати майбутні фінансові потоки, оперативно виявляти ризики та прогнозувати ефективність управлінських рішень. Саме аналітика на основі Big Data забезпечує нову якість прийняття рішень, точнішу, адаптивнішу й таку, що враховує багатофакторну реальність сучасного бізнесу. Значення Big Data у фінансовому прогнозуванні полягає також у здатності надавати актуальні, релевантні й персоналізовані дані для різних підрозділів підприємства. Це дозволяє інтегрувати фінансову аналітику з виробничими, маркетинговими та логістичними процесами, формуючи єдину інформаційно-аналітичну платформу для управління. Застосування великих даних не лише покращує точність прогнозів, а й оптимізує бюджетне планування, підвищує ефективність інвестицій, дозволяє мінімізувати витрати та уникнути фінансових втрат у майбутньому.

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Statement of the problem

Traditional methods of financial analysis and forecasting, based on historical data and static approaches, no longer meet the needs of business in a rapidly changing market. There is a need to implement innovative approaches to forecasting that are able to process both structured and unstructured information in large volumes.

The problem is that a significant part of enterprises does not use the potential of Big Data in financial forecasting due to the lack of appropriate IT infrastructure, qualified personnel, or due to insufficient awareness of the capabilities of such technologies. This limits the accuracy of forecasts, complicates the adoption of informed financial decisions and reduces the competitiveness of the company.

Analysis of latest research and publications

In scientific literature and practice, more and more attention is paid to the topic of Big Data and its application in the economy. Research by scientists, in particular, such as Balabanov O.S., Dzyamudych M.I., Kanygin S.M., Nikitenko K.S., Pichkurova Z.V., Samoilenko L.B. and others, demonstrate the significant potential of Big Data in transforming accounting, auditing and financial forecasting systems.

The works of these authors describe big data analytics tools (for example, machine learning, predictive modeling, natural language processing), but the issue of adapting Big Data to the practice of small and medium-sized businesses in Ukraine, as well as the integration of these technologies into accounting and analytical systems of enterprises, remains insufficiently studied.

Formulating goals

The purpose of the research is:

– study the role of big data technologies in forecasting the financial results of the enterprise;

– analysis of modern information systems that provide Big Data processing;

– identification of the advantages and risks of implementing Big Data in financial activities;

– formulation of recommendations for the implementation of Big Data technologies in accounting practice.

Presentation of the main research material

In the modern digital environment, the term Big Data has gained exceptional popularity in various sectors of the economy, including accounting, auditing, finance, marketing, logistics, and others. This concept has become synonymous with deep analysis, high-speed information processing, and the ability to forecast based on complex models. Despite the frequent use of the term, it is important to understand its essence, characteristics, and significance for the activities of enterprises in the 21st century.

Big Data are extremely large amounts of information that cannot be processed by traditional methods and analysis tools [3, pp. 97-100]. It is not only about large volumes of data, but also about their diversity, speed of receipt, complexity of the structure, and the need for constant updating. The term "big data" first began to be used in the IT environment in the late 90s, but it became truly widespread with the development of the Internet of Things, social networks, mobile devices, cloud technologies, and artificial intelligence.

The classic definition of Big Data is often based on the concept of "5V", which includes five main characteristics of big data (Fig. 1): Volume, Velocity, Variety, Veracity, Value [1, pp. 47-51].

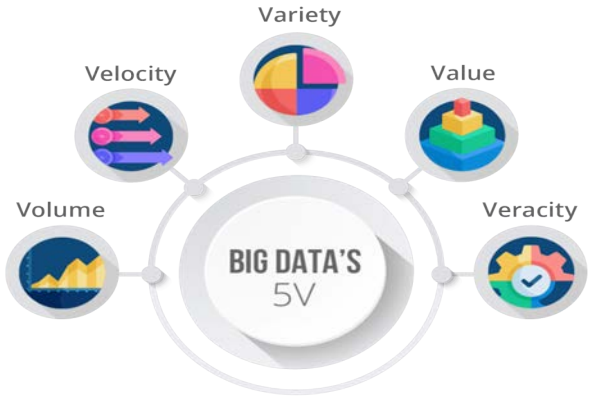

Fig. 1 – The 5Vs of Big Data

Volume is the first and most obvious characteristic of Big Data. Every day, the world creates petabytes of

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information: transaction data, customer orders, sensor data, videos, social media posts, etc. For example, large retail chains collect millions of records of purchases, and banks collect records of customer funds. This data can accumulate for years and has significant analytical potential.

Velocity is the rate at which data is generated, processed, and analyzed. In real time, companies need to be able to respond quickly to changes in the environment, demand, consumer behavior, or financial performance. That is why streaming analytics tools are especially important, providing instant analytics and automated decision-making.

Variety refers to the multiple sources and formats of data. While traditional accounting works with structured numerical tables, Big Data includes text documents, videos, images, recordings from IoT devices, GPS data, customer feedback, audio recordings of conversations, etc. This necessitates the need for new storage and processing tools, including NoSQL databases, cloud storage, and distributed computing.

Veracity refers to the degree of accuracy and reliability of data. In the world of Big Data, much of the information comes from external or unverified sources (for example, social networks or open APIs), so before using it to make management decisions, it is necessary to verify, filter and validate the data. A large amount of noise, repetitions or incomplete records can significantly reduce the effectiveness of the analysis.

Value is the most significant characteristic that determines the economic feasibility of working with Big Data. The presence of large volumes of information in itself does not create advantages, what is important is the ability to turn this data into knowledge, and knowledge into specific actions. For example, analyzing customer behavior based on purchase history, preferences and communications allows you to form personalized offers, increase loyalty and, accordingly, profits.

All this changes the traditional approach to accounting and auditing. Instead of statically collecting information once a month or quarter, organizations are moving to constant monitoring and operational analytics. For example, instead of retrospective analysis of costs, an enterprise can obtain a forecast of future financial results based on current transactions and market behavior in real time [6].

The essence of Big Data also lies in the interaction of three components: data, processing tools and analytical models. Data becomes raw material, tools become means of transformation, and models become a way to obtain value. The most common technologies for processing big data are Hadoop, Spark, Flink, Cassandra, as well as cloud platforms such as AWS, Azure, Google Cloud. They allow processing terabytes of data in a matter of minutes, ensuring scalability, security and flexibility [9].

Big data is radically changing the approach to accounting. For example, an accountant-analyst with Big Data skills can not only prepare financial statements, but also make analytical conclusions about future trends, financial risks, and justify investment decisions. This leads to the emergence of new specialties, such as Big Data accountant-analyst, digital auditor, data economist, etc.

Therefore, the essence of Big Data is a new approach to information processing, which is based on scalability, flexibility, speed and deep analytics. Its characteristics are volume, speed, diversity, reliability and value reflect the key challenges and opportunities facing modern enterprises. The use of big data in the field of accounting and finance opens up new horizons for business development, ensuring accuracy, transparency and proactivity of financial management [2, p. 16-17].

In the modern business environment, the ability to predict future financial results is a key competitive advantage. With the development of digital technologies, traditional approaches to financial forecasting, based on the analysis of past indicators and statistical trends, no longer meet the requirements of a rapidly changing market. In this context, big data technologies (Big Data) are becoming a revolutionary tool for a qualitative breakthrough in the field of financial analytics and forecasting.

Big Data in financial forecasting opens access to a huge array of diverse information, which allows not only to analyze past performance indicators, but also to take into account a wide range of external and internal factors that affect financial results. These can be economic indicators, changes in market prices, consumer behavior, macroeconomic and political risks, customer feedback, seasonal fluctuations, news and even events that are actively discussed in social networks.

One of the key areas of application of Big Data is forecasting the income of an enterprise. Traditionally, this is done on the basis of statistical analysis of sales for previous periods [4, pp. 63-66]. However, Big Data allows you to expand this model by including external environmental factors, weather conditions, dynamics of raw material prices, competitor activity, consumer behavior in real time. Thanks to this, forecasting becomes more accurate, adaptive and personalized. For example, retail chains can predict changes in demand for goods depending on the weather, advertising activity or mass events.

In the area of costs, Big Data allows you to model future costs taking into account the dynamics of purchases, rising resource costs, logistics costs and changes in the structure of suppliers. This makes it possible to identify hidden trends, optimize budgeting and operational planning. Moreover, financial analytics systems based on big data can automatically detect anomalies that signal inefficient use of resources or the risk of fraud.

Big Data plays a special role in the field of risk management. Using machine learning algorithms and neural networks, companies can analyze large data sets on transactions, customer behavior patterns, payment histories, credit ratings and identify potential financial threats. This is extremely important for banks, insurance companies, investment funds and other financial institutions that work with risky assets.

Another example is cash flow forecasting. Accurate planning of revenues and expenses based on historical data, market data, customer and supplier behavior allows companies to avoid cash gaps, plan investments and optimize financing. At the same time, processing such data is possible only thanks to Big Data technologies, which

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combine automatic information retrieval, cloud computing, analytical panels and integration with financial systems.

Financial forecasting using big data also involves building complex mathematical and econometric models. Thanks to this, enterprises can test various scenarios of events, from the most optimistic to critical [7, pp. 71-72]. This is important not only for strategic planning, but also for preparing for crisis situations or unexpected market fluctuations.

A key role in this process is played by such tools and platforms as Apache Hadoop, Apache Spark, Tableau, Microsoft Power BI, Google BigQuery, SAS, IBM Watson Analytics. They provide storage, processing, analysis and visualization of data on a large scale. These tools integrate with corporate ERP systems (e.g., SAP, Oracle), which allows financial analysts to work with information in real time and generate forecast reports with high accuracy [10].

The use of Big Data in financial forecasting also allows to increase the transparency of reporting, to avoid the human factor in the analysis, to reduce the time of preparation of analytical information. In the future, with the development of artificial intelligence and automated analytical systems, companies will be able to almost completely automate the process of making financial decisions based on forecasting models.

However, the introduction of Big Data into the financial sphere is not without challenges. These are high costs for digital infrastructure, the need for highly qualified data analytics specialists, risks associated with confidentiality and cybersecurity, as well as the complexity of adapting big data to national accounting and tax legislation. At the same time, despite these obstacles, the trend of development of Big Data in finance is irreversible. Companies that are the first to adapt these technologies have much higher chances of stable growth and survival in the conditions of global competition.

In the modern world, information technologies play a key role in the process of processing and analyzing big data (Big Data). The rapid growth of digital information generated by enterprises, consumers, social networks, sensors, financial systems and other sources has necessitated the creation of powerful information systems capable of working effectively with Big Data. These systems must provide rapid collection, storage, processing, analysis, interpretation and visualization of data in real time, often in conditions of high complexity, heterogeneity and dynamism of the information environment [5].

Information systems that work with Big Data have a fundamentally different architecture compared to traditional IS. They are based on the principles of distributed data storage and processing, which allows for scalability, flexibility and high performance when working with petabytes of information. The central place in such systems is occupied by cloud technologies, neural network models, machine learning, as well as specialized tools for processing structured, semi-structured and unstructured data.

One of the most popular information platforms for Big Data is Hadoop, an open-source framework designed for distributed storage and processing of large amounts of data. Its core is the Hadoop Distributed File System (HDFS) file storage system and the MapReduce processing engine. Thanks to this architecture, Hadoop is able to run on ordinary servers, combined into clusters, which significantly reduces the cost of processing large amounts of information [8].

Another powerful tool is Apache Spark, which supports in-memory data processing, which makes it much faster than Hadoop in many cases. Spark has modules for SQL queries, stream processing (Streaming), machine learning (MLlib) and graph analytics (GraphX). Due to this, it is widely used in financial systems, analytical services, retail and scientific research.

NoSQL databases are another important component of information systems for Big Data. They allow you to store and efficiently process unstructured and semi-structured data that is not suitable for classic relational databases (SQL). The most common NoSQL solutions include MongoDB, Cassandra, Couchbase, Redis. For example, MongoDB allows you to work with JSON-like documents, which is especially convenient for real-time analytics.

Information systems working with Big Data also actively use visualization and BI (Business Intelligence) tools. These are systems that provide the user with convenient interfaces for viewing, analyzing and displaying data in the form of graphs, charts, dashboards. The most famous of them are Tableau, Microsoft Power BI, QlikView, Looker. They allow you to combine data from different sources, create interactive reports and build predictive models without deep knowledge of programming.

A special place in Big Data systems is occupied by cloud platforms that provide infrastructure as a service (IaaS), platform as a service (PaaS) or analytics as a service (AaaS). The most popular of them are Amazon Web Services (AWS), Google Cloud Platform (GCP) and Microsoft Azure. These platforms provide a secure, scalable environment for data storage and processing, automated machine learning, flexible APIs for integration and convenient analytics.

Modern information systems for Big Data are also closely integrated with artificial intelligence tools [9]. For example, based on the collected data, predictive models can be automatically formed, risks assessed, and recommendations for management decisions formed. This allows significantly improving the quality of financial planning, fraud detection, customer segmentation, and service personalization.

In the financial sector, accounting, and auditing, information systems that work with Big Data are used for detailed transaction analysis, detection of deviations, automation of financial processes, and assessment of counterparties' solvency. They help analysts see the full picture of business processes and make informed decisions based on objective, comprehensive, and up-to-date data.

The versatility of such systems allows them to be integrated with internal corporate ERP, CRM, SCM systems, as well as with open data sources, namely market indices, macroeconomic statistics, news feeds, geodata, etc. This provides multidimensional analysis and support for strategic thinking in enterprise management.

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Table 1 – Information systems and technologies that work with Big Data

System/technology name	Type / category	Main purpose	Advantages	Usage examples
Hadoop	Framework for Big Data	Distributed data storage and processing	Scalability, reliability, processing large amounts of data	Banking transaction analysis, log audit, client action accounting
Apache Spark	Analytical framework	In-memory data processing, fast analytics	High speed, modules for ML, SQL, graphs	Revenue forecasting, risk assessment, credit analytics
MongoDB	NoSQL database	Storing unstructured data	Flexible document structure, scalability	CRM systems, customer feedback analysis, financial operations
Cassandra	NoSQL database	Processing large amounts of data with high availability	High fault tolerance, horizontal scalability	Online analytics, transaction history, financial data flow
Microsoft Power BI	BI platform	Data visualization, reporting, interactive dashboards	User-friendly interface, integration with Excel, cloud availability	Construction of financial reports, cost dynamics, KPI assessment
Tableau	BI platform	Analysis and visualization of data from various sources	Intuitiveness, deep analytics, interactive panels	Sales analytics, management reports, profitability forecasts
AWS / Azure / GCP	Cloud platforms	Storage, processing, machine learning, scalable computing	Security, flexibility, scalability, turnkey services	Platforms for predictive analysis, cyber defense, and financial automation
Kafka	Streaming data processing	Real-time data transmission	Speed, reliability, real-time event processing	Stock market transactions, bank transactions, payment monitoring
Looker (Google Cloud)	BI and analytics	Creating analytical models and reports	Deep integration with Google BigQuery, fast access to data	Financial planning, customer analytics, budgeting
IBM Watson Analytics	AI analytics and data processing	Automated analysis, machine learning	Powerful AI engine, intuitive interface	Identifying financial trends, optimizing costs, assessing profitability

Source: created by the authors based on [9; 10]

The use of Big Data in financial analytics and enterprise management opens up new horizons of efficiency, forecast accuracy and understanding of market dynamics. One of the key advantages is the ability to deeply analyze large amounts of information from various sources – financial transactions, customer bases, social networks, sensor devices. This allows you to build accurate forecast models, quickly respond to changes in the economic environment and make decisions based on data, and not only on intuition or past experience. Companies get the opportunity to see a more complete picture of their business, identify risks at an early stage, detect hidden trends that can affect profitability.

Thanks to Big Data, it becomes possible to personalize customer service. For example, in the financial sector, this allows you to accurately assess creditworthiness, form individual offers, prevent financial losses by quickly identifying fraudulent transactions. An important advantage is the ability to process data in real time, which is extremely valuable for banking, stock trading, logistics management and internal company resources. In addition, Big Data integrates with machine learning and artificial intelligence algorithms, which helps automate operations, reduce costs and accelerate business processes [2, pp. 16-18].

An equally important advantage is the discovery of new business models and sources of profit. Companies can monetize their own data, develop digital services based on them, create new products focused on the needs of specific consumer segments.

However, the implementation of Big Data is accompanied by a number of serious challenges. First of all, it is significant implementation costs: powerful computing resources, licensed software, cloud platforms, as well as personnel training are required. At the same time, the issue of personnel shortage arises – the market urgently needs qualified data analysts, engineers, data science specialists.

Another significant obstacle is the difficulty of integrating Big Data into existing enterprise management systems, especially if they are outdated or unable to handle large amounts of information. No less critical are the issues of data protection and confidentiality: the information collected often includes personal or sensitive data, which requires compliance with strict legal norms, in particular the Ukrainian law on personal data protection or the international regulation GDPR.

The quality of the collected data is also a concern: it can be noisy, duplicated, and irrelevant, which complicates its analytical processing. We should also not forget about the difficulties of scaling Big Data architectures, which require constant updating and adaptation to growing volumes of information.

Finally, even with all the necessary tools, companies may face problems interpreting the results of the analysis. Without a proper understanding of the conclusions obtained, there is a risk of making wrong decisions that can lead to financial losses.

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Conclusions and prospects for further research

As a result of the study, it was found that big data processing technologies are becoming an increasingly important tool in the field of financial forecasting of enterprises. Big Data allows enterprises to more deeply analyze huge volumes of heterogeneous information obtained from internal and external sources, including in real time. This opens up opportunities for more accurate forecasting of income, expenses, cash flows, identification of financial risks and formation of flexible budget policy. The use of Big Data significantly expands the horizons of the analytical capabilities of the enterprise, contributing to the construction of an adaptive and proactive financial management model.

It is important to emphasize that big data not only increases the accuracy of financial forecasts, but also allows you to respond more quickly to changes in the external environment, identify new market trends, change investment priorities and reasonably develop growth strategies. Integration of Big Data with artificial intelligence, machine learning, cloud computing and blockchain technologies allows you to automate complex analytical processes, increase the transparency of financial information, reduce the level of errors and fraud, and also reduce the time for preparing management decisions.

However, the implementation of Big Data in the financial practice of enterprises is accompanied by a number of challenges, among which we can single out the need for highly qualified personnel, significant costs for building an appropriate IT infrastructure, issues of cybersecurity, protection of personal and commercially sensitive data, as well as the need for legal regulation of the circulation of big data. No less important is the issue of adapting management to work in conditions of constantly changing and updated data, because traditional financial approaches require transformation at all levels of decision-making.

In this context, the prospects for further research lie in the in-depth study of specific algorithms and models of financial forecasting based on Big Data, in particular, the construction of neural network models, the application of cluster analysis, regression methods and scenario modeling. The development of information and analytical platforms for small and medium-sized businesses that would ensure the availability of Big Data tools without the need for excessive investments is also a relevant direction. It is worth exploring the possibilities of integrating Big Data with accounting, auditing and management information systems, which will make management reporting more operational, analytically rich and strategically oriented.

Thus, Big Data plays an increasingly important role in financial forecasting processes, providing enterprises with new competitive advantages and strategic opportunities. Further study of this topic will allow not only to better understand the potential of big data in the financial sector, but also to contribute to the formation of new approaches to enterprise management in the era of digital transformation.

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