



e-ISSN 3083-6018

SOCIAL DEVELOPMENT: Economic and Legal Issues

<https://www.eu-scientists.com/index.php/sdel>


Artificial Intelligence in Banking: Modern Models and Implementation Challenges

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ARTICLE INFO

ABSTRACT

Research Article

DOI:

[10.70651/3083-6018/2025.12.05](https://doi.org/10.70651/3083-6018/2025.12.05)

Received:

29 October 2025

Accepted:

30 November 2025

Published online:

14 December 2025

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The article substantiates the relevance of the use of artificial intelligence in the banking sector in the context of rapid digitalization, the growth of online transactions and the strengthening of cyber threats. The purpose of the study is to analyze modern AI models used to detect fraud, manage risks and improve the security of financial transactions, as well as to compare the practices of their implementation in the USA, Great Britain, EU countries and Ukraine. The theoretical basis is provided by machine learning methods, deep neural networks, ensemble algorithms and hybrid AI architectures, capable of analyzing large data sets in real time and detecting complex behavioral patterns. The results obtained demonstrate significant differences in the level of technological maturity of banking systems in different countries. The USA and Great Britain are actively implementing hybrid models and graph neural networks to detect complex fraudulent schemes, while EU countries focus on Explainable AI, ensuring compliance with regulatory requirements. Ukraine focuses on the development of transaction monitoring, classification algorithms and anomaly detection models, which allows for increasing the accuracy of risk assessment of operations. It is shown that the use of AI contributes to reducing the number of fraudulent transactions, accelerating data analysis, optimizing internal processes, reducing operating costs and improving the customer experience. At the same time, key barriers to implementation were identified: insufficient explainability of models, high requirements for IT infrastructure, a shortage of specialists and the need to harmonize regulatory standards. The conclusions emphasize that the effective development of intelligent banking systems is possible if technical modernization, increased regulatory support and the implementation of transparent self-learning models are combined. This will ensure increased financial security, resistance to modern fraudulent schemes and the formation of a competitive digital banking environment compatible with international standards.

KEYWORDS

Artificial Intelligence, banking sector, AI applications, fraud, risks, banking operations, approaches to the application of AI.



e-ISSN 3083-6018

СОЦІАЛЬНИЙ РОЗВИТОК: економіко-правові проблеми

<https://www.eu-scientists.com/index.php/sdel>



Штучний інтелект у банківській сфері: сучасні моделі та виклики впровадження

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СТАТТЯ

АНОТАЦІЯ

Дослідниця

DOI:

[10.70651/3083-6018/2025.12.05](https://doi.org/10.70651/3083-6018/2025.12.05)

Отримана:

29.10.2025 р.

Прийнята:

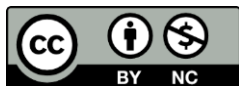
30.11.2025 р.

Опублікована:

14.12.2025 р.

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У статті обґрунтовано актуальність застосування штучного інтелекту у банківській сфері в умовах стрімкої цифровізації, зростання обсягів онлайн-транзакцій та посилення кіберзагроз. Метою дослідження є аналіз сучасних моделей ШІ, що використовуються для виявлення шахрайства, управління ризиками та підвищення безпеки фінансових операцій, а також порівняння практик їх впровадження у США, Великій Британії, країнах ЄС та Україні. Теоретичну основу становлять методи машинного навчання, глибокі нейронні мережі, ансамблеві алгоритми та гібридні AI-архітектури, здатні аналізувати великі масиви даних у режимі реального часу та виявляти складні поведінкові патерни. Отримані результати демонструють суттєві відмінності у рівні технологічної зрілості банківських систем різних країн. США та Велика Британія активно впроваджують гібридні моделі та графові нейронні мережі для детектування складних шахрайських схем, тоді як країни ЄС роблять акцент на Explainable AI, забезпечуючи відповідність регуляторним вимогам. Україна зосереджується на розвитку транзакційного моніторингу, алгоритмів класифікації та моделей виявлення аномалій, що дозволяє підвищувати точність оцінки ризиковості операцій. Показано, що використання ШІ сприяє зменшенню кількості шахрайських транзакцій, прискоренню аналізу даних, оптимізації внутрішніх процесів, зниженню операційних витрат та покращенню клієнтського досвіду. Водночас виявлено ключові бар'єри впровадження: недостатню пояснюваність моделей, високі вимоги до IT-інфраструктури, дефіцит фахівців та потребу у гармонізації нормативних стандартів. У висновках підкреслено, що ефективний розвиток інтелектуальних банківських систем можливий за умови поєднання технічної модернізації, посилення регуляторної підтримки та впровадження прозорих самонавчальних моделей. Це забезпечить підвищення фінансової безпеки, стійкості до сучасних шахрайських схем і формування конкурентоспроможного цифрового банківського середовища, сумісного з міжнародними стандартами.

КЛЮЧОВІ СЛОВА

штучний інтелект, банківська сфера, застосування ШІ, шахрайство, ризики, банківські операції, підходи до застосування ШІ.

1. Introduction

The purpose of this article is to study modern methods of applying artificial intelligence in the banking sector, in particular in the direction of fraud detection, risk management and improving the security of financial transactions [1; 2; 17]. The relevance of the study is determined by the rapid development of digital technologies and the need for banks to ensure a high level of reliability in the face of growing cyber threats and an increase in the number of online transactions [12].

Theoretically, the application of artificial intelligence in the banking sector is based on the use of machine learning, deep neural networks, classification and forecasting models, which makes it possible to automatically analyze significant data sets [2; 10]. These technologies recognize complex behavioral patterns of customers, provide credit risk assessment, and make it possible to monitor transactions in real time [7; 9]. An important characteristic of modern AI systems is the ability to self-learn, which determines their adaptability and increased accuracy of decisions in the process of data accumulation [10; 15].

The rapid digitalization of the financial sector has led to a sharp increase in the volume of online transactions, which, in turn, has increased the level of financial and cyber risks [12; 23]. Traditional approaches to threat detection have shown a limited ability to provide adequate speed and accuracy of response in a situation where transactions are executed instantaneously, and the amount of data increases. That is why artificial intelligence has become a key tool for strengthening financial security: it allows you to identify the slightest anomalies and block suspicious transactions even before damage is caused [7; 10].

Within the framework of this goal, it is important to comprehensively study how modern artificial intelligence methods are used in the banking sector, in particular for fraud detection, risk management and improving the security of financial transactions, as well as which approaches demonstrate the highest effectiveness in different countries. In 2023–2025, the most common were machine learning models for scoring, deep neural networks for anomaly detection, and combined AI architectures combining fraud detection, risk forecasting, and behavioral analytics [1; 10]. The development of these technologies is uneven: countries with a high level of digital maturity demonstrate more active implementation of automated solutions, while financial institutions in Ukraine focus mainly on improving the accuracy of transaction monitoring systems and integrating anomaly models into cyber defense systems [7; 23].

2. Literature Review

Today, one of the key areas in the Ukrainian scientific discourse is the study of modern methods of applying artificial intelligence in the banking sector, in particular in the direction of fraud detection, risk management and improving the security of financial transactions. The increased digitalization of the financial sector has led to a sharp increase in the volume of online transactions, which, in turn, has increased the level of financial and cyber risks. In the modern scientific literature, the issue of the use of artificial intelligence in the banking sector is considered in the works of such researchers as M. Alhaddad [2], R. Abbasov [1], authors of financial and technical studies in the field of credit scoring and anti-fraud systems [7; 9; 10; 23], as well as scientists who analyze trends in the development of digital technologies and their impact on risk management of banking institutions [12; 17]. Researchers highlight the growing role of machine learning, deep neural networks, predictive models, and hybrid AI architectures in fraud detection, credit risk assessment, and increasing the cyber resilience of financial infrastructure. At the same time, despite a significant array of works, comprehensive studies that would simultaneously cover the development of artificial intelligence methods, their effectiveness in 2023–2025. and implementation challenges in different countries are still lacking. This determines the need for an in-depth analysis of modern approaches and practices that form the basis for the effective and safe use of AI in the banking sector [17; 18; 25].

3. Problem Statement

Despite the rapid spread of artificial intelligence technologies in the banking sector, there are still a number of unresolved issues that limit the effectiveness of their application. First of all, we are talking about the lack of transparency and explainability of algorithms, which complicates their use in the field of credit scoring and risk management. A significant problem is also the growth of cyber threats, which require adaptive models capable of quickly detecting complex fraudulent patterns in the face of a large number of transactions. In addition, there is an uneven level of technological maturity in different countries, which affects the pace of implementation of AI solutions and the quality of cyber defense. Limited opportunities for scaling intelligent systems, a shortage of specialists, the need to modernize IT infrastructure and harmonize algorithms with regulatory requirements remain relevant for Ukraine. Together, this creates a need for a comprehensive analysis of modern AI methods, assessment of their effectiveness and determination of directions for further development in the financial sector.

4. Methods and Materials

The methodology of research on the use of artificial intelligence in the banking sector is based on a combination of quantitative and qualitative methods of analysis, which provides a comprehensive disclosure of the problem. In the course of the work, a systematic and critical review of scientific publications, analytical reports of international financial organizations, regulatory documents and the results of modern empirical research on fraud detection, risk management and financial security using AI technologies was systematized and critically reviewed. This approach allows us to cover both general theoretical aspects of the functioning of intelligent systems and practical cases of their use in the world's leading banking institutions.

Particular attention is paid to the analysis of algorithmic approaches used in financial institutions: machine learning, deep neural networks, combined architectures, and Explainable AI. Quantitative methods are used to compare the performance of different groups of models, evaluate accuracy, data processing speed, and the ability of algorithms to detect anomalies in transactional flows. The qualitative analysis covers the assessment of the practices of implementing intelligent systems in different countries, their compliance with regulatory requirements and the peculiarities of integration into the internal processes of banks.

The methodical approach is complemented by an analysis of international cybersecurity standards, current trends in financial digitalization, and banks' adaptation practices to growing cyber threats. The combination of analytical, comparative and predictive methods provides an opportunity to comprehensively assess the potential of AI, identify key risks of its application and form scientifically based recommendations to improve the security and efficiency of banking operations.

5. Results and Discussion

Comparison of approaches allows us to highlight common and distinctive features of the introduction of AI in the banking sector (Table 1). In the US and UK, hybrid models combining machine learning and graph neural networks are actively used to detect complex financial fraud schemes, while EU countries are focusing on Explainable AI models to ensure compliance with regulatory requirements [9; 17]. Ukraine demonstrates an increase in the use of transaction classification algorithms and behavioral models that allow for automatic assessment of the riskiness of client transactions in real time [7; 15].

Table 2 shows that the level of development of artificial intelligence technologies in the banking sector differs significantly between the studied countries, which is due to both the technological maturity of financial systems and regulatory requirements. The data shows that the US and UK demonstrate the highest level of integration of deep neural models and hybrid architectures aimed at detecting complex fraudulent patterns and improving behavioral analytics. The countries of the European Union pay more attention to the interpretation of algorithms and compliance with regulatory norms, which affects the choice of models and the pace of implementation. Ukraine occupies an intermediate position: the implemented solutions effectively provide real-time monitoring of transactions, but the level of scalability and technological complexity of the models is still inferior to the

leading financial systems. This means that the further development of the Ukrainian banking sector requires strengthening the infrastructure for working with big data, expanding the use of hybrid models and deepening the use of self-learning algorithms, which will increase resilience to modern fraudulent schemes and form a level of security comparable to international standards.

Table 1. Comparison of the use of AI methods in banking systems of different countries in 2023–2025

Country	Main applications of AI	Types of models	Implementation Rate	Features of development
Ukraine	fraudulent transaction detection, risk management, cybersecurity	ML classification, anomaly models	medium	focus on transactional monitoring and adaptive systems.
USA	fraud-detection, credit scoring, anti-fraud monitoring of big data	deep networks, graph neural networks	high	emphasis on high-precision hybrid models.
United Kingdom	AML control, risk forecasting, automated scoring	explainable AI, ensemble-models	very high	priority of regulatory compliance and transparency of algorithms.
EU countries(total)	creditworthiness assessment, transaction monitoring	XAI models, ML regressions	medium-high	strict regulations, interpretation requirements.

Source: Compiled by the authors based on [1; 9; 12; 7; 15; 17].

In addition to countering fraud, AI plays a crucial role in the comprehensive management of credit, operational, and cyber risks [1; 2; 9]. Machine learning algorithms in credit scoring use a wider set of parameters than traditional methods, which increases the accuracy of predicting default [9; 19]. In the field of operational risks, AI constantly monitors internal processes and detects system errors. In cybersecurity, intelligent systems form multi-level protection, which makes it possible to respond to threats before they are implemented [12; 23]. In the Ukrainian banking sector, these technologies are also widely used, which indicates the market's focus on the modernization of risk management and compliance with international standards [13; 19; 20].

Table 2. Key benefits and expected effects

Advantage	Description / expected effect
Reduction of fraudulent transactions	AI algorithms detect anomalous transactions and fraudulent schemes in real-time
Increase the speed of transaction analysis	Automatic analysis of large data sets allows you to respond to threats instantly
Ability to work with large amounts of data	AI processes historical and current data, ensuring the accuracy of predictions
Reducing operating costs	Automation of routine processes reduces the need for manual labor and resource-intensive checks
Improving customer experience	Customized solutions and quick response increase customer satisfaction
Improve system reliability and stability	Predictive models allow you to prevent risks and optimize management processes

Source: Compiled by the authors based on [7; 9; 10].

Table 3 shows that the use of artificial intelligence in banking institutions provides a simultaneous increase in security, transaction processing speed, forecast accuracy, and efficiency of internal processes. This means that the implementation of machine learning algorithms and self-learning models allows banks not only to quickly detect fraudulent transactions and minimize financial risks, but also to optimize resources, increase the stability of systems, and improve the quality of customer service. Thus, the key benefits of AI together form the basis for more reliable, faster and predictable operations of financial institutions, which is critically important in today's digital environment [7; 9; 10].

Table 3. Comparison of key trends

Country/Region	Level of application of AI	Key tools	Key results
USA	high	Explainable AI, deep learning, centralized anti-fraud platforms	Maximum accuracy of models, minimization of fraud
United Kingdom	high	Predictive analytics, ML Risk Management	Risk forecasting and approval automation
EU	Medium-high	Regulatory Focus on Explainable AI, Cyber Defense	Increase system resilience and solution transparency
Ukraine	medium, with an upward trend	ML models in transactional monitoring, automated scoring	Improving the efficiency of operations and adapting to international standards

Source: Compiled by the authors based on [12; 17; 19; 20; 23].

The analysis of global trends indicates the active digital transformation of financial institutions in countries with a high level of technological maturity, primarily in the United States, Great Britain, and the EU countries. In these countries, the key ones are the deployment of Explainable AI, the use of centralized platforms for exchanging information about fraud, as well as the widespread use of predictive models in credit scoring [12; 23].

Ukraine, despite the war and the complexity of economic conditions, is demonstrating a dynamic movement towards the modernization of banking technologies. NBBs are actively implementing automated transactional monitoring platforms, using deep learning elements in risk analysis systems, and gradually integrating model transparency requirements in line with European standards [19; 20]. At the same time, the level of digital infrastructure and investment is inferior to the leading countries, which necessitates further reforms (Table 4).

Table 4. Comparative Performance of AI Algorithms for Banking (2023–2025)

Algorithmic group	Characteristics	Strengths	Limitations
Logistic Regression, Decision Trees	Linear and basic ML methods	High transparency, auditability, speed	Lower accuracy for complex anomalies
Random Forest, Gradient Boosting	Multifactor ensemble methods	High accuracy and stability, noisy data handling	Not always suitable for real-time
ANN, LSTM, CNN	Deep Learning	Highest accuracy, detection of complex patterns, work with big data	High cost, low explainability
Hybrid models (SEM+ANN, ML+rule-based)	Integration of multiple approaches	Maximizing accuracy, adaptability	Complexity of implementation and maintenance

Source: Compiled by the authors based on [1; 7; 9; 10; 15].

The data in Table 4 demonstrate that different algorithmic approaches to applying artificial intelligence in the banking sector have their own advantages and limitations. This means that the choice of a specific model depends on the tasks and priorities of the banking institution: basic ML methods provide transparency and speed, but are inferior in accuracy in complex anomalies; ensemble methods increase the accuracy and stability of data processing, but are not always suitable for real-time work; deep learning allows you to identify complex behavioral patterns and process large amounts of data, but requires significant resources and has low explainability; Hybrid models combine the advantages of different approaches, providing maximum accuracy and adaptability, but make implementation and maintenance difficult. Thus, in order to achieve efficiency in fraud detection, risk management and ensuring the security of financial transactions, it is advisable to apply a combination of methods adapted to the specific context of the bank [1; 7; 9; 10; 15].

Our latest survey shows that a higher proportion of respondents report the use of AI by their organizations, even though the majority have not yet scaled the technology. The proportion of respondents who say their organizations use AI in at least one business function has increased since our research last year, with 88 percent reporting regular use of AI in at least one business function, up from 78 percent a year ago. But at the enterprise level, the majority are still in the experimentation or piloting

phase (Figure 1), with about a third reporting that their companies have begun scaling their AI applications.

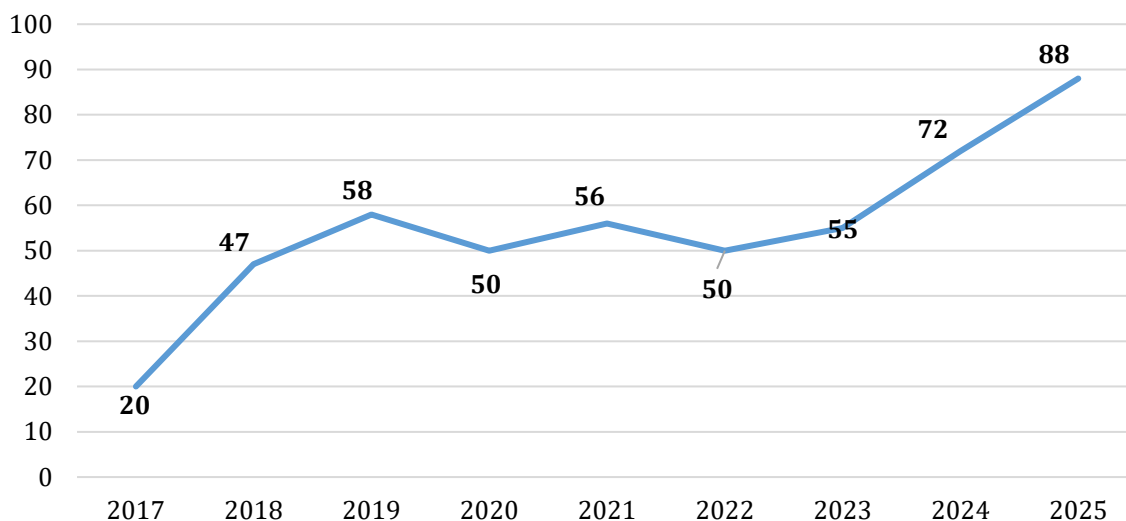


Figure 1. Use of AI by organizations

Source: Compiled by the authors.

According to McKinsey's global surveys on the state of artificial intelligence, 2017–2025 [26] the use of artificial intelligence continues to grow.

At the same time, the implementation of AI requires taking into account a number of related challenges. One of the key issues is to ensure transparency and explainability of algorithms, which is critical for minimizing model bias in lending or risk assessment [1; 17]. It is also important to comply with the regulations for the protection of personal data in accordance with the GDPR and national legislation. For the effective operation of the systems, banking institutions need trained personnel capable of developing and monitoring models, as well as a modernized IT infrastructure that will ensure the continuity of the functioning of numerous data analysis systems [19]. Regular audit and control of models remain a prerequisite for reliability and security [7; 12].

In international practice, the systematic application of AI has already become the foundation for the development of financial institutions, where countries with a high level of digitalization are actively implementing Explainable AI, standardized protocols for exchanging threat information, and national cyber defense platforms [7; 12; 23]. Compared to such states, Ukraine is moving in the appropriate direction, but it needs further improvement of the regulatory framework, investments in digital transformation and the unity of interbank standards [19; 20].

Artificial intelligence not only increases the level of security but also forms new strategies for the development of the financial sector, ensuring the competitiveness of banks in a dynamic digital environment [7; 12; 23]. Realizing the potential of AI requires a comprehensive approach that includes algorithm transparency, staff training, infrastructure modernization, and compliance with data protection standards. Studies for 2023–2025 unanimously confirm that AI is becoming a strategic factor in the development of financial systems and one of the most effective tools for ensuring their resilience [9; 12; 15].

A comparative analysis of machine and deep learning algorithms and international practices confirms that the strategic direction of the banking sector development is a combination of high accuracy of models in compliance with the requirements for transparency and cybersecurity, modern methods of machine and deep learning create significant opportunities for improving the efficiency of risk management, optimizing operations and ensuring the financial stability of banks.

AI-powered chatbots and virtual assistants provide round-the-clock support, personalized financial advice, and faster transaction processing, improving customer experience and operational efficiency [8; 24].

Mobile banking and augmented reality improve customer engagement and satisfaction by offering convenient and interactive banking solutions [8].

Artificial intelligence systems analyze large data sets to detect suspicious activity in real time, which significantly increases the accuracy of fraud detection [8; 16; 24].

Artificial intelligence improves risk management by analyzing transaction data to identify patterns and anomalies, thereby improving credit risk assessment and overall risk management [3; 13; 14; 16].

Artificial intelligence uses machine learning and predictive analytics to predict market trends, optimize investment portfolios, and provide customized recommendations for financial products [11; 24].

Artificial intelligence aids in making decisions about loans and credits by accurately assessing creditworthiness, thereby providing better access to credit for underrepresented groups [22; 24].

Artificial intelligence automates repetitive tasks, reducing operating costs and errors, while increasing efficiency [6; 21].

AI systems predict potential system failures and trigger emergency alarms, ensuring smooth banking operations [8].

Artificial intelligence is expected to continue to expand in the banking sector, with new technologies such as federated learning, quantum computing, and blockchain further revolutionizing risk management and operational practices [5].

Artificial intelligence is likely to enable the provision of more personalized banking services, increasing customer loyalty and competitive advantages for banks [4; 20].

Leading countries are already moving to integrated risk management platforms that simultaneously cover transaction analysis, scoring, and financial threat forecasting [12; 17]. Ukraine is moving in the same direction, but needs to further expand investments in digital infrastructure, staff training, and develop regulatory mechanisms for Explainable AI regulation [19; 20].

Artificial intelligence (AI) is significantly transforming the banking sector, increasing productivity, reducing costs, and improving customer satisfaction.

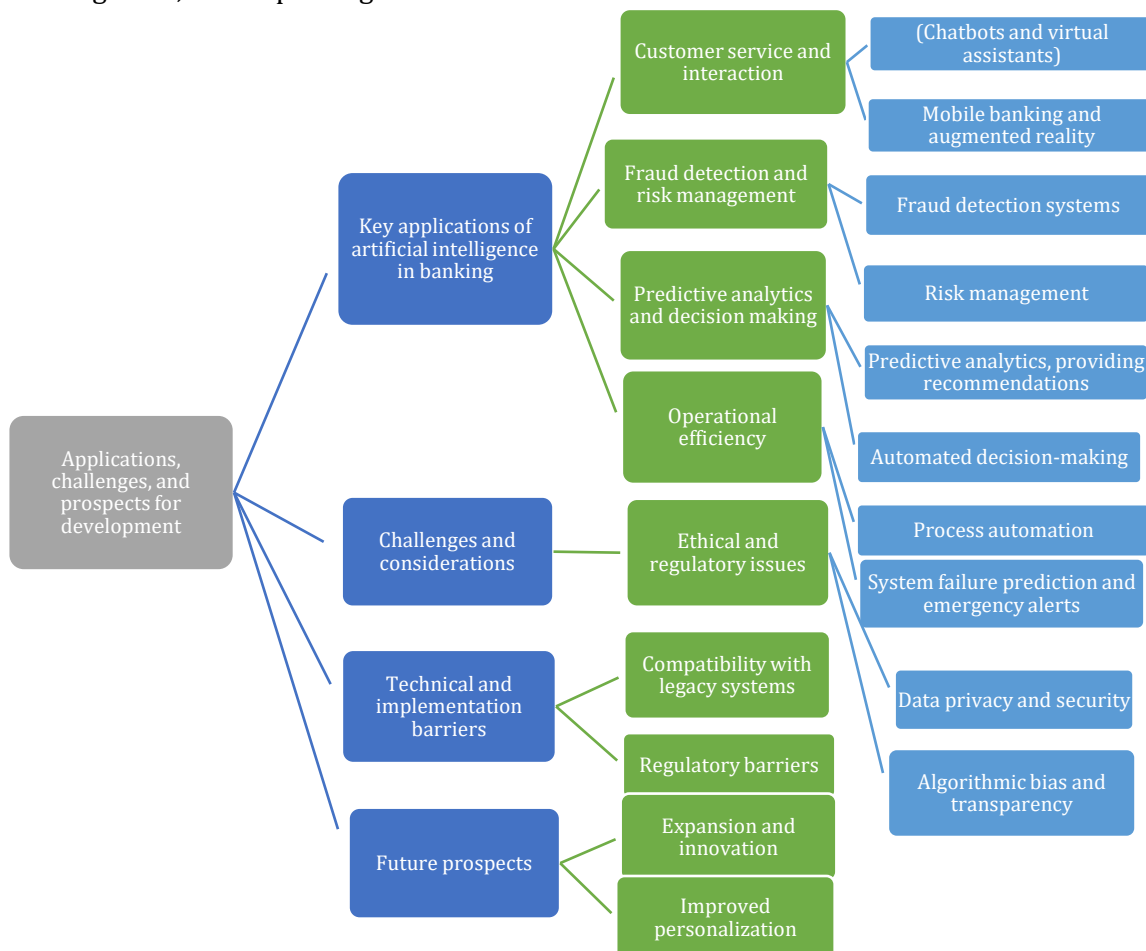


Figure 2. Key Applications and Impact of AI in Banking

Source: Compiled by the author based on data from [3; 8; 16; 19; 24].

6. Conclusions

The study confirmed that artificial intelligence is becoming a key tool for improving the security, efficiency and resilience of banking systems in the world. Analysis of modern models has shown that machine learning, deep neural networks, ensemble algorithms, and hybrid AI architectures provide a significant increase in fraud detection accuracy, improved risk forecasting, and optimization of financial institutions' internal processes. A comparison of the practices of different countries showed significant differences in the level of technological maturity and regulatory approaches: the US and the UK demonstrate the highest level of integration of complex models, the EU countries focus on interpretation and compliance with regulatory requirements, while Ukraine focuses on the development of transactional monitoring and adaptive anomaly detection systems.

The results of the study confirm that the adoption of AI provides a reduction in fraudulent transactions, increased data analysis speed, reduced operational costs, and improved customer experience. At the same time, a number of barriers have been identified, including insufficient explainability of models, high requirements for IT infrastructure, a shortage of qualified specialists, and the need for harmonization of regulatory standards. These factors are holding back the scaling of intelligent systems, especially in countries with less developed digital infrastructure.

Summing up, it can be argued that the further development of banking intelligent systems requires an integrated approach that combines technical modernization, improvement of the regulatory environment, development of human capital and the introduction of transparent self-learning models. The implementation of these conditions will contribute to the formation of a high-level financial security, increasing the resilience of banks to modern cyber threats and ensuring competitiveness in the international financial market.

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