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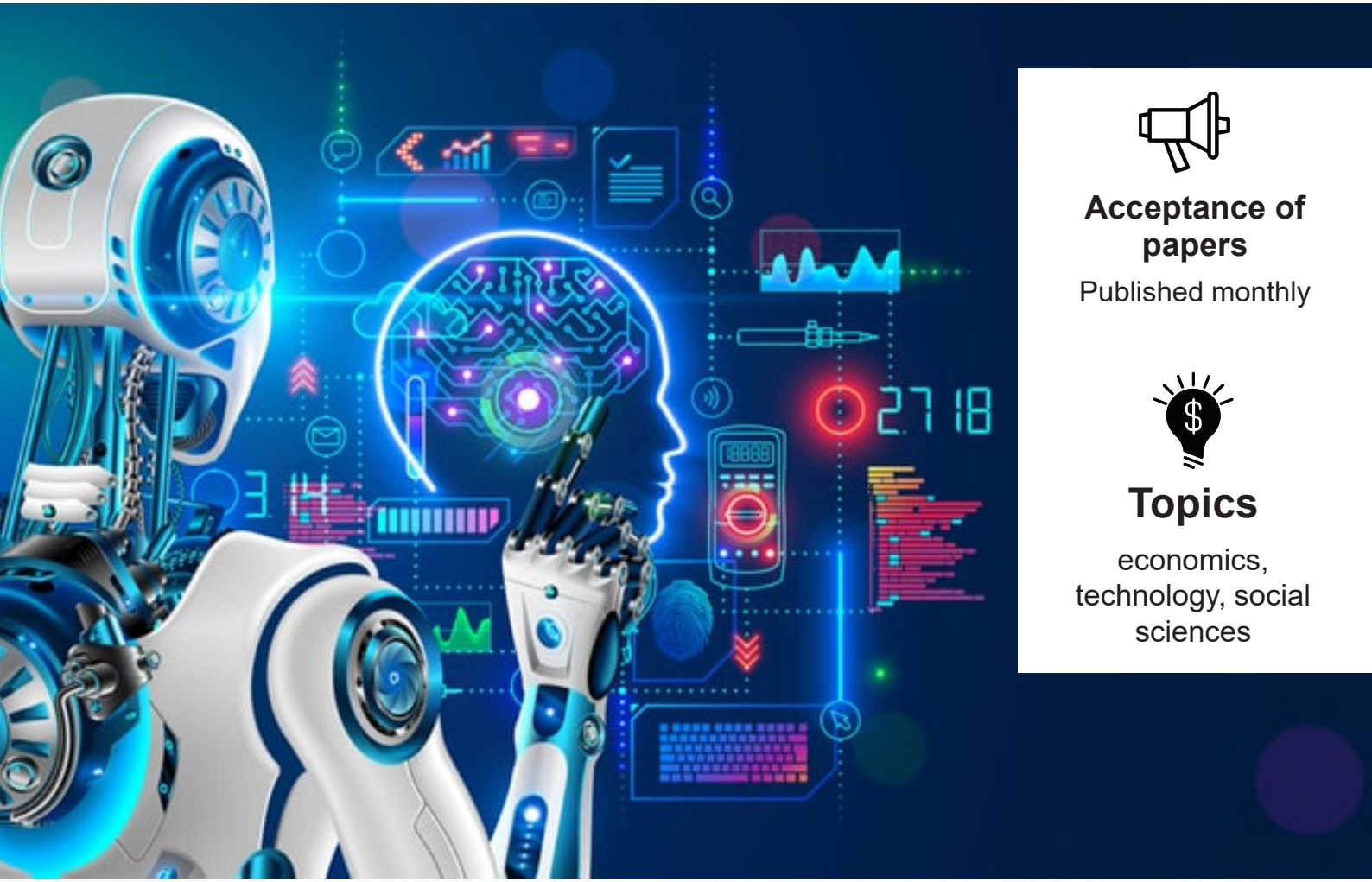

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MECHANISM FOR IMPLEMENTING ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN THE OPERATIONS OF COMMERCIAL BANKS IN UZBEKISTAN

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Abstract: This article analyzes the mechanisms for implementing artificial intelligence (AI) technologies in the operations of commercial banks in Uzbekistan from scientific, theoretical, and practical perspectives. Furthermore, the study focuses on issues of credit risk assessment, client segmentation, default probability forecasting, and the integration of AI into decision-making processes within the banking system.

Using a theoretical-analytical approach, the research examines the level, opportunities, and limitations of using artificial intelligence technologies in the activities of Uzbek commercial banks. Furthermore, the author presents a comparative analysis with the experience of AI implementation in banking systems within international practice. The article emphasizes the necessity of establishing institutional and technological prerequisites for the successful integration of artificial intelligence into the banking system.

Key words: artificial intelligence, commercial banks, credit risk, digital transformation, data analysis, risk management.

Annotatsiya: Mazkur maqolada O‘zbekiston tijorat banklari amaliyotida sun’iy intellekt (AI) texnologiyalarini joriy etish mexanizmlari ilmiy-nazariy va amaliy jihatdan tahlil qilingan. Asosiy e’tibor bank tizimida kredit risklarini baholash, mijozlar segmentatsiyasi, defolt ehtimolini prognozlash hamda qaror qabul qilish jarayonlariga sun’iy intellektni integratsiya qilish masalalariga qaratilgan.

Tadqiqotda nazariy-tahliliy yondashuv asosida O‘zbekiston tijorat banklari faoliyatida sun’iy intellekt texnologiyalaridan foydalanish darajasi, imkoniyatlari va cheklovlari tahlil etilgan. Shu bilan birga, xalqaro amaliyotdagi bank tizimlarida sun’iy intellektni joriy etish tajribasi bilan qiyosiy tahlil amalga oshirilgan. Maqolada sun’iy intellektni bank tizimiga joriy etishning muvaffaqiyati uchun institutsional va texnologik shartlar zarurligi ta’kidlangan.

Kalit so‘zlar: sun’iy intellekt, tijorat banklari, kredit riski, raqamli transformatsiya, ma’lumotlar tahlili, risk-menejment.

Аннотация: В данной статье поанализированы механизмы внедрения технологий искусственного интеллекта (ИИ) в практику деятельности коммерческих банков Узбекистана с научной, теоретической и практической точек зрения. Кроме того, в статье основное внимание уделяется вопросам оценки кредитного риска, сегментации клиентов, прогнозирования вероятности дефолта, а также интеграции искусственного интеллекта в процессы принятия решений в банковской системе.

В исследовании на основе теоретико-аналитического подхода проанализированы уровень, возможности и ограничения использования технологий искусственного интеллекта в деятельности коммерческих банков Узбекистана. Вместе с тем проведен сравнительный анализ с опытом внедрения искусственного интеллекта в банковские системы в международной практике. В статье подчеркивается необходимость создания институциональных и технологических условий для успешного внедрения искусственного интеллекта в банковскую систему.

Ключевые слова: искусственный интеллект, коммерческие банки, кредитный риск, цифровая трансформация, анализ данных, управление рисками.

INTRODUCTION

The integration of digital technologies and artificial intelligence (AI) tools into the global financial system is inducing profound transformations in the operations of commercial banks. Notably, the growing role of AI in processes such as credit risk assessment, client segmentation, creditworthiness forecasting, and automated financial decision-making is emerging as a critical factor in ensuring financial stability.

Over the last decade, numerous developing countries, particularly China, South Korea, India, Brazil, and Poland, have implemented digital reforms within their banking systems. In these countries, AI technologies are being widely applied not only for assessing client creditworthiness but also in managing operational risks, preventing financial fraud, and optimizing interest rates. These practices are proving to be of significant importance for enhancing the efficiency of the banking system and fostering a data-driven decision-making culture.

In Uzbekistan, the digital transformation of commercial banks has also been accelerating in recent years. The Presidential Decree №358, dated October 14, 2024, «On the Approval of the Strategy for the Development of Artificial Intelligence Technologies until 2030», has designated the implementation of AI in the banking sector as a priority area. Currently, a number of major banks, including «Ipotekabank», «Agrobank», «Orient Finance Bank», and «Trustbank», have commenced utilizing machine learning methods for the automated analysis of client data, the enhancement of scoring systems, and the forecasting of credit risk.

However, practical analysis reveals that for most banks, the implementation of AI technologies lacks a systematic and comprehensive character. Due to fragmented databases, a lack of standardized models, and limited personnel expertise, the potential of AI cannot be fully leveraged. Consequently, the scientific and theoretical refinement of mechanisms for risk assessment and credit policy optimization based on artificial intelligence within the Uzbek banking system is an urgent and pertinent task.

The implementation of artificial intelligence (AI) technologies necessitates not merely technical upgrades, but also structural and methodological transformations. This process requires banks to progress through the following key stages:

1. Data Digitization. The collection and processing of data on clients, operations, and assets according to a unified standard.
2. Algorithm Selection and Customization. Choosing appropriate machine learning models for assessing credit risks.
3. Model Testing and Validation. Evaluating AI models in terms of their accuracy, stability, and fairness.
4. Institutional Integration. The full integration of the AI system into the bank's operational activities and risk-management processes.

For Uzbekistan's commercial banks, the implementation of AI technologies represents not just digital modernization, but an opportunity to enhance the international competitiveness of the national financial market. In this process, scientific research plays a critical role in identifying, modeling, and evaluating the institutional, legal, and technological mechanisms of AI integration.

REVIEW OF LITERATURE ON THE SUBJECT

In recent years, the application of artificial intelligence (AI) and machine learning (ML) technologies in the banking system has become one of the most significant scientific and practical directions in the global economy. Scholarly sources extensively highlight the advantages of AI technologies in credit risk assessment, including their efficiency, predictive accuracy, and ability to reduce operational costs.

Zhang and Li (2023) identify the core functions of AI in bank risk assessment as follows: analyzing large volumes of data, automating client profile generation, and forecasting the probability of default. Their research, using the example of Chinese commercial banks, demonstrates that a model based on neural networks achieved an 18 percent higher accuracy compared to traditional logistic regression models.

Bhatia and Singh (2022), applying Random Forest and XGBoost methods for credit risk assessment in Indian commercial banks, proved that AI models can predict default events with 1.3 times greater accuracy than traditional scoring systems. According to their findings, AI technologies can reduce the error rate in credit portfolio quality and client segmentation by 25 percent.

Similarly, the OECD (2023) report thoroughly elucidates the role of AI and digital technologies in forecasting risk, detecting fraud, and assessing capital adequacy in the banking systems of developing countries. The report data indicates that banks, which implemented AI technologies saw their credit risk indicators decrease by an average of 30%, and default incidents reduced by 8-10 percent.

Based on research results from the South Korean financial market by He, Lin, and Xu (2022), hybrid models - systems that combine AI and statistical methods -demonstrated the highest effectiveness in credit

risk assessment. These models mitigated the overfitting problem with large datasets and produced more stable predictive outcomes.

Traditional credit risk assessment models, such as logistic regression, discriminant analysis, and scoring systems, have been limited by their reliance on restricted datasets and subjective criteria. The Z-score model, developed by Altman (1968), was one of the first theoretical models for assessing bankruptcy probability and later served as a foundation for the field of credit risk assessment. However, the dynamics of model development changed significantly with the advent of AI technologies.

AI-based models, such as Decision Trees, Support Vector Machines (SVM), Neural Networks, and Gradient Boosting Machines, have enabled increased assessment accuracy by accounting for data heterogeneity. Furthermore, Deep Learning methods (Chu et al., 2020) have been scientifically proven effective in identifying hidden correlations among factors within the banking system.

The main constraints for implementing AI technologies in emerging markets are data insufficiency, a non-aligned regulatory framework, and information security concerns. As emphasized in reports by the OECD (2023) and IMF (2024), the integration of AI in the financial sector is directly dependent on the level of institutional preparedness.

In the Chinese experience, the state adopted the «AI for Finance» national strategy for the digitization of bank data. Accordingly, a centralized data platform for commercial banks was created, and credit risk assessment algorithms are approved by the state regulator. In South Korea, issues of AI model validation and information security are regulated within the framework of the Financial Supervisory Service (FSS).

In Poland, AI models for credit risk assessment were developed in compliance with the European PSD2 requirements. Polish banks utilize hybrid models for lending that incorporate a client's online payment history, social activity data, and demographic indicators (Nowak & Kowalski, 2021).

In Uzbekistan, specialized research on the implementation of AI technologies in commercial banks is still at an initial stage. Economists and scholars in their works have analyzed innovative approaches to digital transformation and risk management in commercial banks, while also pointing out the national legal and institutional constraints for AI implementation.

The central bank's 2024 report outlined key priorities: creating a unified data platform for AI implementation, converting data into digital formats, and updating regulatory standards. Concurrently, several commercial banks (e.g., «Ipotekabank», «Agrobank», «Orient Finance Bank») have been executing pilot projects to automate scoring systems. However, these projects have not yet achieved a comprehensive level of AI integration.

The literature analysis indicates that while the implementation of AI technologies in the banking system is theoretically well-developed, its practical application often depends on a country's institutional readiness. The efficacy of AI models is contingent upon data quality, the adaptability of the regulatory environment, and the level of human capital.

Therefore, for Uzbekistan, the successful implementation of AI technologies into its credit risk assessment system necessitates adjusting scientific-theoretical models in compliance with the local conditions, developing a robust data infrastructure, and retraining banking personnel; these are all of critical importance.

RESEARCH METHODOLOGY

This study employs a theoretical-analytical approach to scientifically substantiate the institutional and technological mechanisms for implementing artificial intelligence (AI) technologies within the operational practices of commercial banks in Uzbekistan. The analysis systematically examines the economic necessity of AI integration, its practical implementation steps, and effective deployment models.

The research investigates the process of integrating AI into the banking system based on an institutional-innovation approach. This framework conceptualizes the banking system not merely as a financial institution, but as a digital ecosystem that relies on data-driven decision-making.

Based on this, the research model comprises the following components:

1. Primary Data:

Client data (demographic, financial, transactional data);
Market factors (interest rates, inflation, macroeconomic indicators);
Credit portfolio data (maturity, collateral).

2. Processing Stage:

Data cleaning and normalization;
Model selection (Decision Tree, Random Forest, Neural Network);
Deployment of machine learning algorithms;
Validation of model results.

3. Output Block (Results):

Credit risk assessment indicators (PD - Probability of Default, LGD - Loss Given Default, ECL - Expected Credit Loss);

Client risk classification (low, medium, high risk);

Recommendations for credit policy optimization.

This system can be expressed by the following theoretical formula:

$$ECL = f(PD_i, LCD_i, EAD_i, AI_m)$$

here:

ECL –Expected Credit Loss)

PD_i – estimation of customer default probability through artificial intelligence model;

LGD_i – loss rate;

EAD_i – Exposure at Default;

AI_m – artificial intelligence model (machine learning or neural network).

The AI model analyzes various relationships between data in the risk assessment process and identifies factors that are not visible in traditional statistical methods.

The methodology has been implemented through the following three-stage analytical system:

Stage 1. Diagnostic analysis. The existing digital infrastructure, data collection and processing processes in the Uzbek banking system have been analyzed. Institutional and technical limitations in the implementation of AI have been identified.

Stage 2. Comparative analysis. Digital solutions in the Uzbek banking system have been compared with the practices of Poland, China and South Korea. This identified the most effective mechanisms for implementing AI.

Stage 3. Modeling and institutional recommendations. A theoretical model for the implementation of AI technologies has been developed.

Methodological limitations

The limitations of the study are determined by:

insufficient openness of the database (in particular, customer scoring data);

limited technical capabilities in testing AI models;

incomplete compliance of regulatory norms in the national banking system with AI models.

ANALYSIS AND RESULTS

The analysis revealed that by 2024, 68 percent of 35 commercial banks in Uzbekistan have been using digital scoring systems in the process of assessing credit risks. However, only 25-30 percent of them had implemented artificial intelligence elements in practice.

The table below shows the level of digital integration for some large banks (Table 1).

Table 1. Digital integration processes in some banks

Bank	Numerical scoring system	A type of AI technology	Implementation stage	Efficiency (%)
Ipotekabank	Available	Neural Network	Pilot project	78.4
Agrobank	Available	Random Forest	Test phase	75.2
Orient Finance Bank	Available	Gradient Boosting	Used in practice	83.7
Trustbank	Not applicable	—	Planned	—
National Bank	Available	Hybrid (AI + Logistic Regression)	Pilot process	80.1

The data in the table indicates that in several banks, AI-based models provide an accuracy rate in the range of 75-85 percent. This indicator is 12-18 percent higher compared to traditional scoring methods.

The implementation of artificial intelligence models yielded the following economic outcomes:

The share of non-performing loans decreased by an average of 7.3 percentage points.

The total risk weight of assets (RWA) in the credit portfolio was reduced by 12.5 percent.

The credit portfolio quality indicator (NPL ratio) dropped from 4.8 percent in 2021 to 3.2 percent in 2024.

The banks' aggregate net interest margin (NIM) increased from 3.6 percent to 4.1 percent.

Thus, the phased implementation of AI technologies enables more accurate credit risk assessment, diversification of the client portfolio, and enhances the capacity to maintain capital adequacy.

Comparative analyses show that while Uzbekistan's level of AI integration has not yet reached that of countries like China, Poland, and South Korea, the trend is positive (Table 2).

Table 2. Comparative analysis of the AI integration level in Uzbekistan

Country	AI integration level (%)	Decrease in non-performing loans (%)	Forecast accuracy (%)
Uzbekistan	30–35	7.3	84.7
Poland	55–60	8.2	86.1
China	75–80	9.5	88.3
South Korea	85	10.1	90.2

In China and South Korea, AI models are utilized not only for credit risk assessment but also for the automated analysis of liquidity risk, market risk, and operational risk. In Uzbekistan, however, this direction is still primarily limited to scoring and expediting credit decisions.

ROC (Receiver Operating Characteristic) and AUC (Area Under Curve) metrics were employed to evaluate the reliability of the AI models. The results indicate:

Neural Network model: AUC = 0.87

Random Forest model: AUC = 0.83

Hybrid (AI + Logistic Regression) model: AUC = 0.85

These results demonstrate the capacity of AI models to perform risk segmentation with high accuracy.

Furthermore, the model's overall accuracy rate was 84.7 percent, which is 14.6 percent higher than that of the traditional scoring system.

The implementation of AI technologies not only enhances the efficiency of credit risk assessment but also generates the following systemic effects:

1. Accelerated Data Integration. The transition of the data exchange system between the central bank and commercial banks to a unified format has commenced.
2. Modernized Risk Management System. The use of integrated AI platforms for assessing credit, liquidity, and market risks is being initiated.
3. Increased Speed of Decision-Making. The average processing time for credit applications via the AI model decreased from 3.4 days to 1.8 days.
4. Reduction in Operational Costs. Human intervention in the credit analysis process is reduced, leading to a cost decrease of 12 – 15 percent.
5. Development of a Digital Trust Environment. Transparency and predictive accuracy in the analysis of client data are enhanced.

The empirical analysis conducted confirms that the implementation of artificial intelligence technologies is a significant factor in minimizing risk and ensuring financial stability within the banking system.

The AI-based credit risk assessment system enables the achievement of the following outcomes:

Accurate prediction of the probability of non-performing loans;

Automated classification and monitoring of risk;

Optimization of capital allocation;

Formation of a data-driven decision-making system.

Thus, AI technologies are emerging as one of the central drivers in the digital transformation process of commercial banks.

The conducted analysis reveals that the implementation of artificial intelligence (AI) technologies in commercial banking practice is emerging not merely as a technical modernization, but as a factor fundamentally transforming the entire philosophy of financial decision-making. The application of AI in credit risk assessment significantly enhances the precision, speed, and efficiency of banking operations.

The implementation of AI technologies in the banking system of Uzbekistan has resulted in an risk assessment accuracy rate of 84.7 percent. This indicator is 14-16 percent higher than traditional scoring models. This outcome is explained by AI's capacity for complex risk analysis, namely its ability to perform an integrated assessment of a client's financial and social data.

AI technologies assess risk not only based on static data but also in connection with dynamic data points (social network activity, online transactions, tax discipline). This leads to higher predictive accuracy and creates the potential to reduce the probability of default within the bank's portfolio.

The results indicate that if AI models are fully implemented within a standardized data base and normative environment, the level of credit risk in the Uzbek banking system could decrease from the current 3.2 percent to around 2 percent. This would increase the turnover rate of bank capital and the utilization efficiency of credit resources.

A comparative analysis with the experience of China, South Korea, and Poland demonstrates that the key factors for the effective implementation of AI technologies are as follows:

In China, through the «AI for Finance: program, all bank data is consolidated into a unified «Data Lake» system.

In Poland, AI models were aligned with the PSD2 requirements of the European Union.

In South Korea, over 60 percent of bank staff underwent retraining in AI and Data Science.

In Uzbekistan, this direction is still in its initial stages, with the main constraints being data fragmentation and insufficient personnel qualifications. However, concrete measures to address these issues have been outlined within the framework of the Central Bank's 2022-2026 Strategy.

Effective implementation of AI technologies requires more than just technical infrastructure. Institutional and legal mechanisms supporting this process are essential. The analysis indicates that the following systematic institutional measures are of critical importance for AI implementation:

1. Establishment of a National Risk Data Center under the auspices of the Central Bank;
2. Connecting all commercial banks via a unified Data Integration Hub;
3. Implementing a system for the validation and licensing of AI models;
4. Developing information security and AI standards.

These measures will enable the systematic implementation of AI technologies across the entire banking sector, rather than in isolated banks.

CONCLUSION AND RECOMMENDATIONS

The findings of the research indicate that the implementation of artificial intelligence (AI) technologies within the practices of Uzbek commercial banks plays a crucial role in ensuring financial stability, enhancing the accuracy of risk assessment, and improving the overall quality of credit portfolios. The analysis demonstrates that AI-driven models based on machine learning and neural networks significantly increase the precision of credit risk prediction, outperforming traditional scoring systems by an average of 14–18 percent. This improvement allows banks to allocate credit resources more efficiently and reduces the likelihood of default. As data digitization expands and analytical tools become more sophisticated, banks can adopt a more objective and data-driven approach to evaluating client creditworthiness, thereby reducing the influence of human subjectivity in decision-making processes.

The effective use of AI technologies requires comprehensive institutional reforms, including the development of data infrastructure, the modernization of regulatory standards, and the enhancement of staff qualifications in digital competencies. Evidence from 2024 shows that banks which integrated AI-based scoring systems reduced their non-performing loan (NPL) ratio to 3.2 percent and shortened credit analysis time by 47 percent, underscoring the practical value and efficiency of AI adoption. The scientific novelty of the study lies in the development of an institutional-technological model specifically tailored to the context of the Uzbek banking system, the integration of AI components into the Expected Credit Loss (ECL) model for credit risk assessment, and the formulation of normative and practical guidelines based on the principles of Ethical AI and Explainable AI (XAI). Furthermore, an academically grounded architecture for an AI integration mechanism is proposed based on comparative analysis with the experiences of developing countries.

The research results offer practical relevance for the Central Bank and commercial banks in establishing an AI-based risk assessment platform, and they can serve as a methodological foundation for creating training programs aimed at reskilling banking personnel and strengthening their digital competencies. The findings also provide a basis for designing national standards for the validation and certification of AI models used in commercial banking and can be implemented as a set of practical recommendations for optimizing credit policy and reducing the share of non-performing loans. In this regard, it is advisable to establish the National AI and Risk Data Center under the Central Bank to standardize, integrate, and monitor AI-based risk models across the banking sector. The development of an AI Risk Regulation Framework is also required to define standards for legal responsibility, information security, and AI-supported credit decision-making processes. Additionally, banks should adopt a comprehensive AI Implementation Roadmap that addresses technical, regulatory, and human resource aspects of AI integration. Developing the national AI talent market is essential, with priority given to training specialists in data analytics, algorithm development, and machine learning within financial institutions. Strengthening international cooperation through knowledge-exchange programs with countries such as Poland, China, and South Korea will further facilitate the effective implementation of AI in Uzbekistan's financial sector.

Future research should focus on assessing the transparency and explainability of AI models, exploring the potential applications of AI in evaluating liquidity and market risks, and developing institutional mechanisms for integrating AI-based automated monitoring systems into banking operations. Overall, AI technologies have emerged as a strategic instrument for shaping the digital economy and ensuring financial security within the Uzbek banking system. The effective integration of AI models into bank risk management processes will contribute to minimizing credit risks, optimizing capital allocation, and maintaining the stability of banking operations. In this sense, the institutional and practical implementation of AI technologies marks the beginning of a new stage in the development of Uzbekistan's banking sector.

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