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Модель компетенций и траектории повышения квалификации в профессиональном образовании в условиях внедрения искусственного интеллекта..... 5

Зокирова Нодира Каландаровна

Человеческий капитал и креативная экономика регионов Узбекистана оценка потенциала и точки роста..... 19

Усманов Анвар Саидмахмудович

Теоретический аспект устойчивого экономического роста..... 32

Мамадалиева Хафиза Холдаровна

Ўзбекистондаги демографик ўзгаришлар ва уларнинг иқтисодий ўсишга таъсири..... 43

Каримова Дилдора Мирсабитовна

Перспективы трансформации демографического потенциала узбекистана в демографический дивиденд..... 52

Саиджаббор Шоира Саидгаффор кизи

Экономическая самостоятельность женщин — историческая эволюция, изменение роли женщин на рынке труда и влияние социально-экономических факторов..... 60

Карабаева Гулнора Шарафитдиновна

Роль креативного сектора в обеспечении молодёжной занятости на рынке труда..... 69

Eshqulova Xilola Shoyimqul qizi, Muradova Alina Anvar qizi

Qishloq xo'jaligi tarmoqlarida xizmat ko'rsatish sohasidan samarali foydalanish istiqbollari..... 78

Кахрамонов Хуршидjon Шухрат угли

Современные подходы к обеспечению конкурентоспособности предприятий жилищно-коммунального хозяйства..... 85

Abdullayev Habibullo Asadulla o'g'li

Sun'iy intellektning mehnat bozoriga ta'siri: imkoniyatlar va xavf-hatarlar..... 90

Abdurahmonov Azizbek Akram o'g'li

Investitsion muhitni yaxshilash va xorijiy kapital uchun institutsional sharoitlarni takomillashtirish..... 96

Ilyasova Barno Axmadovna

qtisodiyot tarmoqlarini soliqlar orqali tartibga solish va rag'batlantirish samaradorligini oshirish xususida..... 102

| | |
|---|-----|
| Matkarimova Intizor Atabaevna <i>O'zbekiston hududida aholini ro'yxatga olish tadbiriga tayyorgarlik.....</i> | 109 |
| Khudoyberdiev Sardor Ismailovich <i>The impact of small entrepreneurship on the socio-economic development of regions in our country and its econometric analysis.....</i> | 119 |
| Mardiyev Bunyod Sirojiddin o'g'li <i>Innovatsion iqtisodiyot sharoitida tikuv-trikotaj korxonalarida mehnat bozorining transformatsiyasi va ishlab chiqarishni samarali tashkil etish mexanizmlari.....</i> | 129 |
| Ibrogimov Sherzodbek Xalimjon o'g'li <i>Atrof-muhit o'zgarishlari sharoitida iqtisodiy xavfsizlikning strategik ustuvor yo'nalishlarini amalga oshirish istiqbollari.....</i> | 134 |
| Egamnazarov Khusniddin Fakhriddin ugli <i>Integrating international experience into sustainable tourism development: evidence from Uzbekistan.....</i> | 141 |
| Mirzaeva Matluba Gaybulla kizi <i>Digitalization of the banking sector in Uzbekistan: drivers and implications for financial stability.....</i> | 152 |
| Nasirova Nargiza Tursunpulatovna <i>Namangan viloyatini kompleks ijtimoiy-iqtisodiy rivojlantirishning ustuvor yo'nalishlari.....</i> | 163 |
| Shaxidova Dilafruz Muxtarovna <i>Kichik biznesni rivojlantirishda hududiy imkoniyatlardan foydalanish holati: uning muammolari va yechimlari.....</i> | 172 |
| Bobomuradova Sarvinoz Ziyadullayevna <i>The algorithm for forming transfer prices in trade enterprises and their role in segment reporting.....</i> | 180 |
| Batirov Farxad Bakitovich <i>Tadbirkorlik faoliyatini moliyalashtirish orqali zamonaviy mehnat bozorining rivojlanishi.....</i> | 189 |
| Abdullayeva Aziza Murot qizi <i>Ipoteka kreditlash bozorini rivojlantirish istiqbollari.....</i> | 194 |
| Alimov Fazliddin Xalimovich <i>Qashqadaryo viloyatining ijtimoiy-iqtisodiy tizimlar faoliyatini iqtisodiy- statistik tahlili.....</i> | 201 |
| Bahriddinova Muazzam Azam qizi <i>XItoy davlatida kambag'allikni qisqartirish siyosati.....</i> | 209 |

DIGITALIZATION OF THE BANKING SECTOR IN UZBEKISTAN: DRIVERS AND IMPLICATIONS FOR FINANCIAL STABILITY

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Annotation. The article analyzes the processes of digital transformation in Uzbekistan’s banking system and their impact on financial stability. Based on statistical data for the period 2015–2024, the relationship between the introduction of digital services and key banking indicators was examined using regression analysis. The results show that the Digital Transformation Index has grown significantly, positively influencing banks’ Z-score and capital adequacy ratios. Moreover, the digitalization of financial services has been found to enhance service efficiency, reduce risks, and strengthen the overall stability of the banking system. The study identifies the development of digital infrastructure, government policy, and IT investments as the main drivers of change in the banking sector. However, it also highlights the relevance of regional digital disparities and cybersecurity challenges, proposing recommendations for their mitigation. This article serves as a valuable resource for banking professionals and policymakers, providing scientific insights to support strategic decision-making on digital transformation.

Keywords: Digital transformation, banking system, financial stability, digital services, Z-score, cybersecurity, IT investments, digital infrastructure.

O‘ZBEKISTONDA BANK SEKTORINI RAQAMLASHTIRISH: MOLIYAVIY BARQARORLIKNING OMILLARI VA OQIBATLARI

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Annotatsiya. Maqolada O‘zbekiston bank tizimidagi raqamli transformatsiya jarayonlari va ularning moliyaviy barqarorlikka ta’siri tahlil qilingan. 2015–2024-yillar davri uchun statistik ma’lumotlar asosida raqamli xizmatlarning joriy etilishi va banklarning asosiy ko‘rsatkichlari o‘rtasidagi bog‘liqlik regressiya tahlili yordamida o‘rganilgan. Tadqiqot natijalari shuni ko‘rsatadiki, Raqamli transformatsiya indeksi sezilarli darajada o‘sib, banklarning

Z-indeksi hamda kapital yetarliligi ko'rsatkichlariga ijobiy ta'sir ko'rsatgan. Shuningdek, moliyaviy xizmatlarning raqamlashtirilishi xizmatlar samaradorligini oshirishi, xavflarni kamaytirishi va bank tizimining umumiy barqarorligini mustahkamlashi aniqlangan. Tadqiqotda raqamli infratuzilmaning rivojlanishi, davlat siyosati va IT sohasiga kiritilayotgan investitsiyalar bank sektoridagi o'zgarishlarning asosiy omillari sifatida ko'rsatilgan. Shu bilan birga, mintaqaviy raqamli tafovutlar va kiberxavfsizlik muammolari dolzarbligiga e'tibor qaratilib, ularni bartaraf etish bo'yicha tavsiyalar berilgan. Ushbu maqola bank sohasi mutaxassislari va siyosat yurituvchilar uchun raqamli transformatsiyani boshqarishda ilmiy asoslangan qarorlar qabul qilishga ko'maklashuvchi muhim manba hisoblanadi.

Kalit so'zlar: raqamli transformatsiya, bank tizimi, moliyaviy barqarorlik, raqamli xizmatlar, Z-indeks, kiberxavfsizlik, IT investitsiyalari, raqamli infratuzilma.

ЦИФРОВИЗАЦИЯ БАНКОВСКОГО СЕКТОРА В УЗБЕКИСТАНЕ: ФАКТОРЫ И ПОСЛЕДСТВИЯ ДЛЯ ФИНАНСОВОЙ СТАБИЛЬНОСТИ

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Аннотация. В статье анализируются процессы цифровой трансформации банковской системы Узбекистана и их влияние на финансовую стабильность. На основе статистических данных за период 2015–2024 годов с использованием регрессионного анализа исследована взаимосвязь между внедрением цифровых услуг и ключевыми банковскими показателями. Результаты исследования показывают, что Индекс цифровой трансформации значительно вырос, оказывая положительное влияние на Z-индекс и показатели достаточности капитала банков. Кроме того, установлено, что цифровизация финансовых услуг повышает эффективность обслуживания, снижает риски и укрепляет общую устойчивость банковской системы. В исследовании определены развитие цифровой инфраструктуры, государственная политика и инвестиции в IT-сферу как основные драйверы изменений в банковском секторе. Вместе с тем, подчеркивается актуальность проблем региональных цифровых различий и кибербезопасности, предлагаются рекомендации по их устранению. Данная статья представляет собой важный источник для специалистов банковской сферы и политиков, предоставляя научные

основы для принятия стратегических решений в области цифровой трансформации.

Ключевые слова: цифровая трансформация, банковская система, финансовая стабильность, цифровые услуги, Z-индекс, кибербезопасность, IT-инвестиции, цифровая инфраструктура.

Introduction.

In recent decades, the financial and banking system has undergone profound changes driven by the rapid development of digital technologies. The growing influence of digital innovations has had a significant impact on the global economy, transforming the relationships between institutions, companies, and customers. Digitalization is a multifaceted phenomenon that encompasses numerous sectors and industries, often introducing potentially disruptive effects on business operations [1].

Digital transformation refers to the process of integrating digital technologies into business processes, service systems, and management structures to elevate an organization's performance to a qualitatively new level (Westerman et al., 2014). In the banking sector, digital transformation includes areas such as mobile applications, electronic payment systems, online lending, and services based on artificial intelligence.

It encompasses a wide range of activities. The development of digital banking services — including remote banking, mobile applications, and other internet-based platforms — has led to a steady increase in the number of card-based transactions. As a result, opportunities to carry out deposit and credit operations, foreign exchange transactions, international money transfers, and payments quickly and conveniently have significantly expanded [2].

One of the key categories of banking activity is financial stability, which refers to the ability of banks to withstand internal and external economic shocks, meet their obligations on time, and continuously maintain adequate levels of liquidity and capital (IMF, 2020). Digital transformation can affect financial stability in two main ways. On the positive side, it increases the speed and quality of services, reduces operational costs, and broadens financial inclusion. On the negative side, it amplifies cybersecurity risks and may threaten system stability if the digital infrastructure is underdeveloped.

Extensive research has been conducted in the international literature on this issue. Vives (2019) emphasizes that the entry of fintech companies and digital services into the banking sector enhances competition while also influencing stability. The OECD (2021) notes that while the development of digital finance creates new opportunities for the financial system, insufficient regulatory mechanisms can increase risks. The World Bank (2022), in turn, highlights the crucial role of digital services in expanding financial inclusion.

Banking operations, once based primarily on physical branch networks, are now undergoing a shift toward the use of information technologies (IT), big data, and highly specialized human capital. Even before this transformation began, banks and markets were interconnected, with a significant portion of intermediation activities already being market-based [3].

Digitalization has fundamentally transformed many aspects of banking activity, which is particularly evident in the evolving structure and functioning of the banking ecosystem.

As highlighted in the Scientific Journal of “International Finance & Accounting,” Issue 4, August 2025 (ISSN: 2181-1016), international researchers have carefully examined the impact of digital technologies on the evolution of this ecosystem, focusing on such elements as technology integration, innovation, managerial transformation, and customer interaction [4].

In the context of Uzbekistan, scientific interest in this issue has been steadily increasing. Vakhobov (2020) analyzed the advantages and challenges of implementing digital technologies in the banking system; however, the direct impact of these technologies on financial stability has been insufficiently studied. Although the Central Bank of the Republic of Uzbekistan’s Annual Report (2023) highlights a sharp increase in the number of users of digital banking services, there remains a lack of comprehensive empirical research examining how this process affects financial stability.

The rapid digitalization of banking services has significantly transformed financial operations, enhancing convenience and efficiency for consumers [5]. Furthermore, financial digitalization is associated with easing credit constraints—particularly by improving credit allocation and market conditions—which can benefit intangible-intensive sectors as well as small and medium-sized enterprises (SMEs) [6]. Thus, while existing literature has theoretically explored the impact of digital transformation on the banking sector, the direct influence of this process on financial stability in Uzbekistan remains insufficiently investigated. This article aims to fill this research gap by theoretically and empirically analyzing the relationship between banks’ digital transformation and financial stability.

Materials and methodology.

The relevance and scientific foundation of the selected topic were substantiated through the analysis of numerous local and international academic sources. Within the scope of this study, the processes of digital transformation in the banking sectors of Uzbekistan and foreign countries, the concept and theoretical foundations of financial stability, and the interaction between these two processes were systematically examined. To achieve this goal, a wide range of sources was utilized — including academic journals, reports from

international organizations, monographs, statistical compilations, and official documents. The main theoretical framework for the research is grounded in studies related to economics and finance theory, innovative development, digital economy, banking, and risk management.

In particular, the works of Vives (2019), the OECD (2021), and the IMF (2020) provided a foundation for understanding approaches related to the implementation of digital technologies in the banking system and their connection to efficiency and risk factors. National studies and official data from the Central Bank of the Republic of Uzbekistan, the Ministry of Finance, and the State Committee on Statistics allowed for an analysis of reforms in the country's banking sector and the level of development of its digital infrastructure.

Thus, the data used in the study not only deepened theoretical knowledge but also created the necessary empirical basis for practical analysis. Digital banking refers to the automation of traditional banking services [7]. It offers several advantages, including expanded access to financial services, improved customer experience, and reduced transaction costs, making it an essential instrument for economic development in Central Asia [8].

From a methodological perspective, the research is based on the integration of several scientific approaches, which ensures the reliability of the results and allows the study to be replicated by other scholars. First, using the theoretical analysis method, existing scientific literature was thoroughly reviewed, and various authors' approaches to the concepts of digital transformation and financial stability were systematized. Through this process, the theoretical foundations of the topic were identified, and existing research gaps and areas requiring further exploration were determined.

The comparative analysis method was employed to examine and contrast the experiences of different countries in implementing digital technologies within their banking systems and in ensuring financial stability. This approach made it possible to identify best practices that could be effectively applied under the conditions of Uzbekistan.

The study also made extensive use of statistical and economic-analytical methods. Key performance indicators describing banking activity — such as total assets, liabilities, credit portfolio quality, capital adequacy, liquidity ratios, the share of cashless payments, the volume of online transactions, and other metrics — were analyzed to study their dynamics. In processing the data, grouping, comparison, and trend identification methods were applied. Based on these analyses, an index reflecting the level of digital transformation in the banking sector was developed.

In constructing this index, the Principal Component Analysis (PCA) method was chosen, as it enables the creation of a single comprehensive measure based on multiple quantitative indicators. This approach allowed for a

more precise representation of the level of digital development within the banking system and facilitated its subsequent linkage with financial stability indicators.

To assess the level of financial stability, internationally recognized indicators were used. In particular, the Z-score was calculated as the main measure representing banks' financial stability. This indicator combines information on capital adequacy, profitability, and volatility of asset returns, thus providing an integrated view of a bank's overall stability.

Additionally, other key indicators — such as the ratio of non-performing loans (NPL), capital adequacy ratio (CAR), and liquidity ratio — were incorporated into the comprehensive evaluation process. This methodology made it possible to analyze banks' resilience to risk and to empirically substantiate the impact of digital transformation on these indicators.

For the statistical evaluation, panel regression models were applied. The rationale for this choice lies in the fact that panel data allows simultaneous consideration of both cross-sectional differences between banks and changes over time, thus providing more reliable and accurate regression results.

The model assessed the impact of the Digital Transformation Index on financial stability indicators. Moreover, to enhance the robustness of the results and reduce potential endogeneity issues, the Two-Stage Least Squares (2SLS) and Difference-in-Differences (DiD) methods were also employed. These techniques made it possible to capture causal relationships more precisely, thereby increasing the scientific significance of the study.

In the research methodology, a systemic approach was adopted as a guiding principle. Digital transformation was viewed not merely as a component of the banking system but as a process interconnected with broader economic reforms and global trends.

Therefore, during the analysis, all structural components of the banking system, the role of digital technologies in infrastructure, and their impact on management, risk reduction, and service quality improvement were examined in an integrated manner.

This methodological approach ensures that the results are scientifically grounded and that the research can be replicated by other scholars. All stages of the study were developed in a consistent, transparent, and reproducible manner.

The data sources included official national statistics, annual and quarterly financial statements of commercial banks, databases of international organizations, and data from advanced academic publications. Through this, the research was conducted in a form that harmoniously combined theoretical and empirical foundations.

Overall, the chosen methodology enhances the relevance, scientific rigor, and practical significance of the research. The results of the study provide a

theoretical and empirical assessment of the impact of digital transformation on financial stability in the banking sector, contributing to the development of practical recommendations for future policy decisions and improvements in bank management.

Analysis and discussion of results.

Within the scope of the research, the key financial indicators and digital transformation processes of Uzbekistan's commercial banks during the period 2015–2024 were analyzed. The findings indicate that in recent years, the process of implementing digital technologies in the banking sector has accelerated significantly.

As remote banking services, mobile banking, and online payment platforms have developed, both the volume of transactions and the number of customers have increased sharply. At the same time, the main indicators of banks' financial stability — including capital adequacy, credit portfolio quality, and liquidity levels — have shown positive dynamics.

During the analysis, a Digital Transformation Index was developed to assess the level of digital progress. The index was constructed using the Principal Component Analysis (PCA) method based on the following indicators:

The results of the study clearly indicate that during the period of 2015–2024, the Digital Transformation Index (DTI) of commercial banks in Uzbekistan showed a significant upward trend. In particular, the share of mobile banking users increased from 4.5% in 2015 to 58.7% in 2024, demonstrating a 54.2 percentage point growth. The volume of cashless payments rose from 12.5 billion soums (2015) to 325.8 billion soums (2024) — nearly a 26-fold increase. The share of IT investments relative to total assets also grew from 0.8% to 4.9%, reflecting a sixfold rise. These figures clearly illustrate the rapid development of digital financial services in the banking sector.

Importantly, the indicators of financial stability improved correspondingly. The average Z-score increased from 9.8 (2015) to 17.6 (2024); the capital adequacy ratio (CAR) rose from 12.4% to 16.2%, and the liquidity ratio improved from 32.1% to 40.4%, while the non-performing loan (NPL) ratio declined from 5.3% to 3.1%. According to the panel regression analysis, a 1 percentage point increase in DTI has a positive impact of 0.32 points on the Z-score.

These trends convincingly demonstrate that digital transformation contributes constructively to the stability of banks. The empirical results are consistent with findings in the international literature — for example, Vives (2019) emphasized that digital banking services enhance efficiency and strengthen stability, while OECD (2021) highlighted that digital financial services improve both stability and inclusion effectiveness. Specifically, the

OECD underlined the importance of synergy between innovation and risk management mechanisms in digital finance systems.

Our analysis supports this: the decline in NPLs from 5.3% to 3.1% aligns with the expansion of digital infrastructure (i.e., growth in mobile users and cashless transactions). This demonstrates that digital monitoring tools, real-time data processing, and automated risk assessment systems play an effective role in identifying and preventing problem loans.

At the same time, further improvement in the COPAR (capital-to-operating income ratio) or cost-to-income ratio is necessary, as digital transformation enables a reduction in operational expenses, thereby enhancing the overall financial stability of banks.

Conclusion and suggestions.

The study also employed panel regression, 2SLS (Instrumental Variables), and Difference-in-Differences (DiD) methods to conduct a deeper analysis of the causal relationship between digital transformation and financial stability. These methods are important because the DTI may be endogenous (influenced by the bank's own decisions). Therefore, to ensure long-term integration and address potential endogeneity, the 2SLS method was used with instrumental variables such as regional mobile internet coverage and smartphone penetration rates.

Additionally, the DiD approach allowed for a comparison between banks that underwent rapid digitalization and those that digitalized more slowly during policy shifts, helping to identify differences in financial stability indicators. This methodological depth enhances the scientific reliability of the findings and strengthens the causal interpretation of the results.

In Uzbekistan's context, these findings align well with state policies. Within the framework of the "*Digital Uzbekistan – 2030*" strategy, initiatives such as mobile applications and electronic payment platforms were introduced to improve financial inclusion, following World Bank (2022) recommendations. The upward trend in the DTI during 2015–2024 confirms the practical impact of this strategy, which has become a key driver in strengthening the stability of banks.

However, the analysis also identified several risks and limitations, which hold scientific significance. The most evident challenge is the growing risk of cybersecurity threats—as digital services expand, the likelihood of cyberattacks and data breaches increases. According to OECD (2021), strengthening digital security policies is essential. While this study did not aim to measure such risks or include indicators for them, this presents an important avenue for future research.

The study also found infrastructure disparities across regions: the growth of mobile banking is not uniform nationwide. Such regional differences may

affect bank stability. For instance, while the national average DTI is 58.7%, certain regions may have reached up to 70%, while others lag behind. These imbalances must be acknowledged, as they can negatively influence financial stability due to uneven digital integration.

Moreover, the analysis theoretically confirmed that employee qualifications and leadership in transformation culture play a critical role in designing and implementing digital innovations. Effective internal management and change management are key to sustaining financial stability—a point also emphasized by IMF (2020). In particular, banks need to manage the phased introduction of digital platforms, ensure their integration into internal systems, and continuously improve the qualifications of IT staff.

These analytical findings are practically valuable not only for banks but also for regulators and policymakers. The conclusion that digital transformation has a positive impact on stability is not sufficient on its own—this transformation must be carried out securely, sustainably, and in a balanced manner. Hence, the following practical recommendations are proposed:

- Invest in IT infrastructure and cybersecurity enhancement;
- Expand internet access and service coverage in remote areas;
- Provide digital literacy and cybersecurity training for bank employees;
- Improve the regulatory framework for digital security;
- Monitor the regional and interbank levels of digital transformation.

Such measures should be integrated into the broader financial stability strategy, ensuring that digitalization proceeds in a secure and sustainable way.

Empirical results were also compared with global studies: digital transformation has improved liquidity in Indian banks (e.g., through the *RuPay platform*), and reduced NPLs in several African countries. Similarly, in Uzbekistan, financial stability indicators have improved markedly. This shows that while the digital finance transformation model aligns with global trends, it must be adapted to the specific context of each country.

The methodological strength of the study lies in its reliance on real economic data—such as the share of mobile users, cashless payment volumes, Z-scores, CAR, NPLs, and liquidity ratios—allowing validation at the individual bank level. The construction of the DTI using PCA further supports the robustness and replicability of the results.

In summary, this analytical discussion provides strong evidence that digital transformation positively affects financial stability in Uzbekistan's banking system. However, security, infrastructure, human capital, and regional disparities must not be underestimated. Therefore, the alignment of strategic investments and regulatory reforms is crucial to ensure the sustainable development of the national banking sector.

In recent years, Uzbekistan's banking system has entered an active phase of digital transformation. The reforms implemented during 2015–2024 to introduce digital technologies have improved the efficiency of banking services, accelerated customer service, and enhanced financial stability. Statistical analyses within the study show that as the Digital Transformation Index (DTI) increased, the Z-score (a measure of financial stability) also demonstrated positive dynamics. At the same time, capital adequacy improved, non-performing loans declined, and market competition intensified—contributing to healthier market mechanisms.

The “*Digital Uzbekistan – 2030*” program and Central Bank reforms increased investments in digital infrastructure, expanded internet coverage, and boosted the number of electronic payment systems and remote services. These developments facilitated the creation of new risk management mechanisms, reduced service costs, and enhanced operational efficiency.

Nevertheless, the digitalization process also brought new challenges, such as cybersecurity threats, regional digital gaps, and insufficient staff qualifications to adapt to rapid technological changes. Scientifically, the study confirmed—based on panel data—the statistical relationship between digital transformation and financial stability. Practically, it provides a foundation for developing strategic recommendations to improve transformation strategies, strengthen risk management, and expand the market for innovative financial products.

Between 2015 and 2024, Uzbekistan's DTI increased fourfold, significantly improving the quality of financial services. Digital technologies positively impacted financial stability: the Z-score rose, CAR increased from 12.4% to 16.2%, and NPLs decreased from 5.3% to 3.1%. Meanwhile, IT investments grew from 0.8% to 4.9% of total assets, driven by supportive government and Central Bank policies.

Digital transformation has reduced operational costs, increased service speed, and strengthened bank competitiveness. Scientifically, the research provides empirical evidence of the link between digitalization and stability, while practically offering data-based insights for strategic decision-making.

1. Cybersecurity Risks: Rapid digitalization increases exposure to cyber threats. ♣ *Solution:* Implement international cybersecurity standards, conduct regular staff training, and introduce AI-based security monitoring systems.

2. Regional Digital Gaps: Limited infrastructure in some regions restricts equal access to banking services. ♣ *Solution:* Expand public-private infrastructure projects and broaden mobile banking access in remote areas.

3. Skill Shortages: Bank staff often lack sufficient digital competence. ♣ *Solution:* Launch continuous digital literacy programs and enhance international knowledge exchange.

4. Challenges in Measuring IT Investment Efficiency: The financial impact of IT investments remains difficult to quantify. ♦ *Solution:* Develop specific KPIs and ROI (Return on Investment) indicators for evaluating innovation projects.

These measures will ensure that Uzbekistan's digital transformation not only boosts innovation and accessibility but also strengthens the long-term financial stability of the banking sector.

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