Digitalization and the Application of Artificial Intelligence Technologies in the Banking Sector: Effective Cases and Regulatory Aspects

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Abstract

This present research examines the processes of digitalization and the implementation of artificial intelligence (AI) technologies in the banking sector of the Russian Federation. It highlights the ongoing reduction in the number of physical branches of Russian commercial banks as evidence of an active phase of digital transformation in the industry. This transformation is accompanied by the continuous introduction of new digital banking products and services, as well as a growing trend toward the adoption of AI technologies. The research presents key cases of successful AI application, including the automation of customer service, intelligent credit scoring, voice assistants, fraud detection systems, risk management tools, and the personalization of financial services. Simultaneously, the study analyzes regulatory aspects related to digitalization and the use of AI in banking, discussing both international and national approaches to AI regulation and their impact on the development of digital financial services. The case analysis reveals the complexity of AI regulation challenges in Russia. The successful integration of AI in the banking sector depends largely on regulatory frameworks capable of minimizing risks while maximizing the benefits of AI, ensuring the protection of clients' rights and interests. The findings may be of interest to researchers and professionals in banking and information technology, as well as stakeholders engaged in the study and regulation of AI technologies.

Keywords: Digitalization; Artificial Intelligence; Regulation; Digital Maturity; Generative Artificial Intelligence; Digital Maturity.

Introduction

In the era of artificial intelligence, the boundaries between the virtual and real worlds are becoming increasingly blurred. Digital technologies are now utilized across nearly all spheres of society and have become an integral part of the banking sector (Moşteanu et al., 2020).

Given its high sensitivity and adaptability to changes in the external environment, the banking sector has been one of the first to undergo digitalization, including the adoption of artificial intelligence (AI) technologies. This transformation continues at a rapid pace. Banks

constantly introduce new digital products and services that enable them to attract new clients, increase service speed, and apply personalized approaches to each customer (Alt &Puschmann, 2012; Tarkhanova, 2018).

Artificial intelligence is considered one of the key drivers of transformation in the banking industry, offering opportunities to optimize business processes, enhance customer service, and reduce risks (Nosova et al., 2022). Advances in machine learning and neural networks open new possibilities for data analysis, process automation, and the creation of personalized services in banking (Paramesha et al., 2024). Today, there are numerous effective cases of AI implementation within the banking sector.

However, in the process of implementing specific cases, banks face various risks and limitations that necessitate effective state regulation through supervisory and other authorities. Such regulation requires a comprehensive approach, taking into account transparency, data protection, ethical considerations, legal issues, international cooperation, and innovation support. Experts note that in several jurisdictions, AI is regulated through a combination of instruments: hard law, soft law, and self-regulation (Hoffmann-Riem, 2020). At the same time, countries place emphasis on different regulatory tools, and approaches to AI governance vary significantly across jurisdictions (Walter, 2024). Currently, three main approaches to AI regulation are distinguished: restrictive, hybrid, and facilitative.

In Russia, the regulator adheres to a neutral approach to AI regulation, emphasizing the initiative and autonomy of the banking sector in managing the risks associated with AI implementation (Application of Artificial Intelligence in the Financial Market, 2023).

In this study, we present the top 10 cases of AI application in the banking sector and examine how digitalization and artificial intelligence are transforming the banking system, highlighting the benefits for both banks and their clients.

The aim of this article is to examine effective cases of digitalization and the use of artificial intelligence technologies in the operations of Russian banks, as well as to identify the specific features and trigger points in the regulation of digital transformation and artificial intelligence in the banking sector.

Literature Review

Digital transformation promotes the evolutionary development of business models and the implementation of modern conceptual solutions in the banking sector, ranging from improvements in internet banking technologies to the complete transformation of traditional monetary operations (Naimi-Sadigh et al., 2022; Tarkhanova et al., 2018). The adoption of innovative digital technologies serves as a stable foundation for ensuring the long-term and sustainable growth of banking and financial institutions (Mavlutova et al., 2022). Digitalization is currently considered a strategic priority in banking technologies within the global economy (Kolmykova et al., 2022). Artificial intelligence technologies are a key driver of the ongoing changes in the banking sector (Thowfeek et al., 2020).

There are several approaches to understanding the essence of digital transformation in the banking sector. One perspective, according to researchers, views digital transformation as the modernization of a bank's business processes and technologies aimed at increasing operational efficiency and improving customer service (Adewumi et al., 2024; Akamavi, 2005; Küng& Hagen, 2007). Another perspective interprets digital transformation as a shift in market structure, in which an increasing number of players utilize digital technologies to deliver financial services (Diener &Špaček, 2021; Chanias et al., 2019).

Within the broader context of digital economic transformation, the banking sector plays a pivotal role. It is one of the key players in the financial services market and has the potential to leverage emerging technologies to improve its operations. For example, banks can use data analytics to make decisions on credit issuance or investments and employ mobile applications to deliver services to clients.The development of digitalization in the banking industry has progressed through several stages, each of which has significantly altered the methods of service delivery and customer interaction (Table 1). According to the data in Table 1, the digitalization of the banking sector has evolved from the automation of routine operations to the adoption of artificial intelligence, augmented and virtual reality technologies, exploration of quantum computing capabilities, and the implementation of sustainable finance practices.

Table 1:Stages of Digital Transformation in the Banking Sector

Period	Stage
1950s	Automation of routine operations using early computer systems; introduction of the first ATMs
1960s	Development of electronic payments; introduction of bank cards
1970s	Automation of banking operations, including initial attempts at online banking
1980s	Widespread deployment of ATMs and expansion of debit card usage
1990s	Emergence of internet banking; development of electronic payment systems for online transactions
2000s	Introduction of mobile applications and SMS banking services
2010s	Emergence and growth of fintech companies; adoption of blockchain and cryptocurrency technologies
2020s	Implementation of artificial intelligence; development of open banking; enhanced data protection and cybersecurity; expansion of digital banking platforms and ecosystems
2025 (projected)	Adoption of augmented and virtual reality technologies; exploration of quantum computing capabilities; implementation of sustainable finance practices

Source: Compiled by the authors.

Digital banking continues to evolve, with each new stage bringing both opportunities and challenges (Singh et al., 2023). It is essential that the banking sector remains adaptive to emerging technologies and changing customer demands in order to stay competitive and responsive to clients' needs.

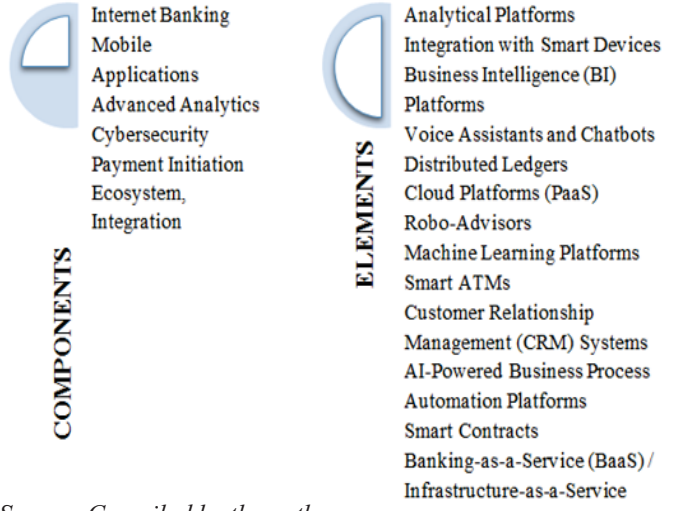
At present, the following major milestones in the digital transformation of the banking sector can be identified:

1. **Emergence of Digital Channels.** This stage includes the development of ATM networks, mobile banking, and chatbots, alongside the formation of a new ecosystem centered around the user. The system enables both banks and clients to interact at any time through multiple communication channels (Fasnacht, 2021).
2. **Development of Digital Products.** This stage encompasses contactless and virtual payments, as well as the use of Big Data (Manimuthu et al., 2021). The application of advanced technologies allows for the creation of end-to-end (E2E) products designed to meet clients' financial needs 24/7.
3. **Implementation of Full- Cycle Information Services.** This stage not only modernizes traditional products but also facilitates the emergence of a new business model that integrates the bank into the global digital environment (Alt &Puschmann, 2012).
4. **Creation of a "Digital Brain".** At this stage, data analysis is automated for auditing purposes, providing banks with a more comprehensive understanding of their operational capabilities within specific industries (Kalyani & Gupta, 2023).
5. **Formation of "Digital DNA".** This concept represents a system that incorporates new vectors of development and strategic decisions capable of adapting to changes at any stage of the bank's lifecycle (Cowhey & Aronson, 2017).

The implementation of digital banking enables institutions to become more flexible and efficient in their operations. Process automation reduces staffing costs and accelerates client request processing. It also simplifies the collection and analysis of large data volumes and enhances risk forecasting (Kaur et al., 2021).

Digital banking functions as a comprehensive system composed of various components and elements that allow customers to access banking services anytime and from anywhere. These systems streamline processes and enhance operational efficiency (Figure 1).

Figure 1:Components and Elements of Digital Banking

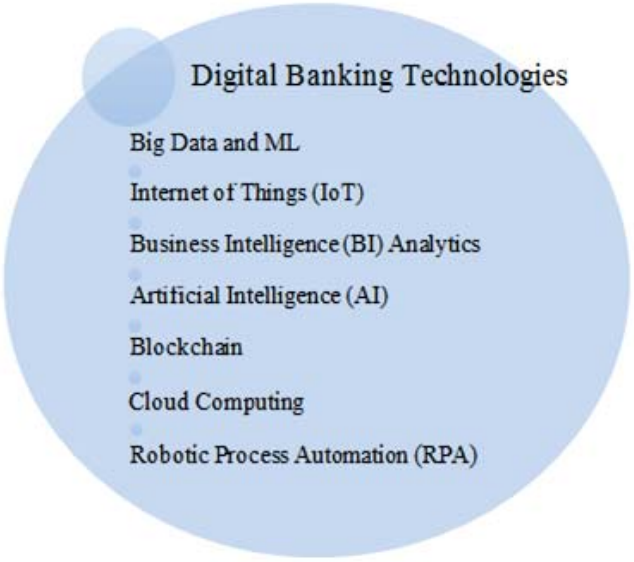


Source: Compiled by the authors.

According to Figure 1, digital banking as a system comprises a wide range of components and elements that interact with one another to deliver convenient, secure, and innovative financial services to customers. It is essential that these components are fully integrated and function in a coordinated manner to ensure maximum efficiency and customer satisfaction.

In this context, artificial intelligence acts as a key enabler in the transformation of traditional banking services into digital formats (see Figure 2).

Figure 2:Digital Banking Technologies



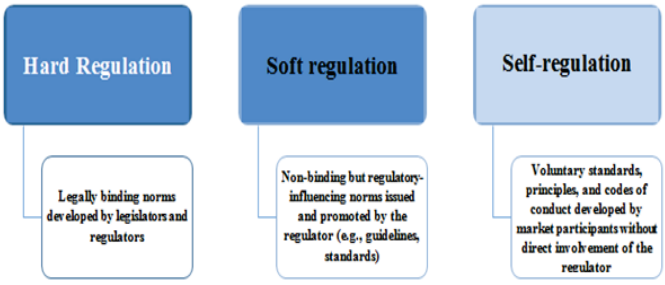
Source: Compiled by the authors.

Artificial intelligence plays a significant role in digital banking by providing banks with tools to enhance customer experience, improve operational efficiency, and ensure security (Mamadiyarov, 2024). The implementation of AI simplifies data collection and processing, enables speech recognition, and facilitates the use of neural networks and biometric data.

However, as digitalization advances and AI technologies become more widely adopted in the banking sector, there is a growing need for regulatory oversight and legal adaptation (ReierForradellas&GarayGallastegui, 2021). Regulatory frameworks governing the digital transformation of the banking industry are undergoing continuous changes, driven by the adoption of new legislative acts in various countries. Regulation plays a key role in ensuring the security, efficiency, and legality of digitalization processes within the banking sector. Areas subject to regulation include data protection and cybersecurity, new forms of payments and financial transactions, privacy issues, and equitable access to digital technologies across all population groups. This regulatory oversight is carried out through a combination of laws and normative acts issued by supervisory authorities.

As artificial intelligence becomes more deeply embedded in banking, the issue of regulating AI-specific applications gains particular relevance. Researchers identify three primary approaches to AI regulation in the banking sector (Figure 3) (Doumpos et al., 2023).Hard regulation refers to legally binding norms developed by legislators and regulators.Soft regulation involves non-binding normative guidelines issued by regulatory bodies to influence market behavior without imposing strict legal obligations.Self-regulation is based on voluntary standards and principles developed by industry participants without direct involvement from the regulator.These approaches represent different levels of regulatory influence on the use of AI in banking.

Figure 3: Main Approaches to the Regulation of Artificial Intelligence in the Banking Sector



Source: Compiled by the authors based on Application of Artificial Intelligence in the Financial Market, 2023

In addition, experts identify three main models of artificial intelligence regulation in the banking sector (Ridzuan et al., 2024):

1. **Restrictive Model.** This approach involves the establishment of strict rules and regulations governing

the development, implementation, and operation of AI systems. It includes bans on the use of certain AI technologies and stringent requirements for high-risk systems. This model is characteristic of the European Union and Brazil.

2. **Hybrid Model.** This approach combines hard regulation, soft law, and self-regulation based on risk assessment principles. It is employed in China, the United States, and Canada. In Russia, the regulatory authorities emphasize the promotion of AI development in the banking sector through a risk-based approach, which aligns with the hybrid model.

3. **Facilitative Model.** This model relies on soft regulatory instruments such as self-regulation and ethical norms, and does not impose restrictive measures on AI. It is typical of the United Kingdom and Singapore.

In the case of Russia, particular emphasis is placed on the application of proportional regulation of artificial intelligence in the banking sector, grounded in the risk-based principle. This principle implies that regulatory requirements are determined by the magnitude and probability of potential risks associated with AI technologies, balanced against the expected positive outcomes of their use.

As part of the implementation of the National Strategy for the Development of Artificial Intelligence, the Bank of Russia has developed conceptual approaches aimed at regulating AI-related relations. These approaches promote the use of risk-based regulation, co-regulation and self-regulation tools, and ethical guidelines (Chaiko, 2025). The Russian model of risk-based regulation incorporates a combination of soft law instruments, self-regulation mechanisms, and targeted normative regulation (Erahtina, 2023).

The range of areas and applications of artificial intelligence in the banking system is constantly expanding. AI is becoming increasingly integrated into banking business processes and is exerting a significant influence on both the broader financial market and the banking sector in particular (Attah et al., 2024). Currently, the most prominent and effective AI application cases are found in the following areas: financial analytics, personalized customer service, automated credit scoring, HR automation, employee workflow optimization, voice assistants, fraud detection, risk and portfolio management, cyberattack prevention, and chatbot-based customer service automation (Adewumi et al., 2024). The application of AI in these domains demonstrates how artificial intelligence is transforming the banking industry as a whole, as well as specific banking products and services delivered to clients.

Methodology

In this research, we assessed the digital maturity of Russian banks, summarized the outcomes of AI adoption in the Russian banking sector, and identified the key features and regulatory challenges related to the use of AI technologies in banking.

The methodology was based on synthesis, induction, deduction, content analysis, and comparative analysis. To achieve the research objectives, we used publicly available data provided by the Bank of Russia, the SDI360 agency, and other analytical and rating organizations.

Results

Between 2020 and 2024, Russian banks significantly accelerated their digital transformation. This resulted in a marked increase in the share of online services and mobile banking. The implementation of artificial intelligence and the automation of processes enhanced operational efficiency and improved the customer experience. Strengthened cybersecurity measures and data protection became top priorities in response to the growing threat landscape. The development of open banking and integration with fintech companies contributed to the expansion of available financial services. As a result of digital transformation, Russian banks became more competitive and better adapted to changing market conditions.

A key trigger and powerful driver of the evolutionary

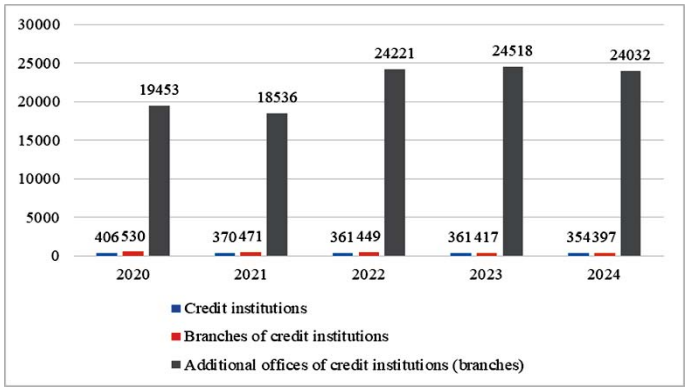
development of digitalization in global and Russian banking was the COVID-19 pandemic in 2020–2021. The epidemiological situation caused by the novel virus placed credit institutions in a critical position. While the adoption of digital banking solutions had previously been a strategic choice influenced by financial capacity and competitive goals, the implementation of anti-COVID measures made digitalization a necessity. Failure to adopt digital solutions resulted in an immediate loss of market position.

Since 2020, digitalization priorities in banking have undergone several changes. Foremost among these were the challenges of ensuring remote work for employees and providing digital banking services, effectively shifting the entire banking operation to an online environment.

It is important to note that, at present, the development of banking infrastructure—based on various software licenses, security systems, and the volume and structure of banking operations—has given rise to a new trend: the automation of banking activities. This shift is largely attributable to the experience gained during the remote work period of the COVID-19 pandemic. Credit institutions have ceased to consider a return to traditional infrastructure models. Instead, they are focused on optimizing modern systems, further reducing office space, and building upon the operational efficiencies achieved through remote work.

Between 2020 and 2023, there was a significant decline in the number of active banks and their structural subdivisions (Figure 4). This was due to a combination of factors: the decreasing financial stability of certain credit institutions, their inability to meet the regulatory requirements set by the Bank of Russia, and a broader trend in the banking sector to reduce the costs associated with maintaining physical branches. The transition to digital (remote) customer service and electronic document management has become a defining feature of this transformation.

Figure 4:Dynamics of the Number of Active Credit Institutions and Their Structural Subdivisions in Russia, 2020–2024



Source: Compiled by the authors.

The observed trend toward a reduction in the number of commercial bank branches illustrates the active digitalization of the banking sector. This includes the continuous introduction of innovative digital banking products, services, and technologies, as well as the growing prevalence of online customer service.

Leadership in digital transformation and the application of artificial intelligence technologies in Russia belongs to systemically important banks, which consistently strengthen their market positions. These institutions invest heavily in the development of digital banking and AI to enhance operational efficiency, improve the customer experience, reduce operating costs, and maintain competitiveness in the context of financial sector digitalization.

Table 2 presents the results of the digital maturity ranking of ten Russian systemically important banks for the period 2022–2024, conducted by the SDI360 agency. In this study, digital maturity is defined as the level of business activity in the digital environment.

The assessment was based on three key indicators:Online Sales; Marketing and Communications; Internet Presence(Digital Maturity Index SDI360°, 2022–2024).

Each indicator was divided into four subcategories, consisting of three measurable parameters. A total of 36 parameters were evaluated, with each parameter receiving a maximum of 10 points. Thus, the overall maximum score was 360.

Table 2:Digital Maturity Ranking of Ten Russian Systemically Important Banks, 2022–2024

Total Score (Min/Max)			Internet Presence (Min/Max)			Marketing & Communications (Min/Max)			Online Sales (Min/Max)		
2022	2023	2024	2022	2023	2024	2022	2023	2024	2022	2023	2024
330/220	310/240	315/245	115/75	115/100	120/90	90/55	90/55	95/60	116/80	105/75	100/80

Source: Compiled by the authors based on the Digital Maturity Index SDI360°, 2022–2024.

In 2022–2023, T-Bank ranked first in the digital maturity index with a total score of 330 points, leading in most of the evaluated categories. However, in 2024, T-Bank was unable to maintain its position, dropping to second place overall with a score of 305 points. This decline was reflected in its scores for Internet presence (115 points) and marketing and communications (95 points), while it fell to fourth place in the online sales category with 95 points. Sovcombank took the lead in 2024, scoring a total of 315 points.

Overall, systemically important banks continue to advance their digital maturity by improving and digitalizing current customer operations, introducing new services, expanding contactless service options, and developing innovative digital banking products and solutions.

To improve efficiency, ensure security, and enhance customer engagement, banks are actively implementing artificial intelligence technologies. Key areas of AI application in the banking sector include:financial analytics; personalized customer service; automated credit scoring; HR automation; employee workflow optimization; voice assistants; fraud detection; risk and portfolio management; cyberattack prevention; chatbot-based customer service automation.

Based on these application areas, the top 10 effective AI use cases among Russian systemically important banks are presented in Table 3.

Table 3:Top 10 Effective Use Cases of Artificial Intelligence Technologies in Russian Systemically Important Banks

Area of AI Application	Use Case	Example Banks
Financial Analytics	Analysis, visualization, and identification of key variables influencing the financial performance of regional banking branches	VTB Bank
Personalized Customer Service	Proprietary and partner-based recommendation systems offering banking services tailored to individual client needs	Sberbank
Credit Monitoring Automation	"Smart" scoring system for assessing customer creditworthiness	Alfa-Bank
HR Automation	Recognition of personal employee documents, including handwritten and low-quality scans, and automatic data entry into HR systems	Sberbank
Staff Workflow Optimization	Automatic passport recognition during off -site customer service visits, particularly for bank card issuance	Otkritie Bank
Voice Assistants	Voice-based assistant capable of interacting in natural language, providing real-time information, and resolving inquiries	VTB Bank
Fraud Detection	Fraud detection service enabling dynamic risk assessment, temporary payment suspension, and real-time alerts	T-Bank
Risk and Portfolio Management	Online capital management tool for Premium and Private Banking clients	Rosbank
Cyberattack Prevention	AI-powered cybersecurity threat management system	Sberbank
Customer Service Automation via Chatbots	Chatbot enabling customers to communicate with the bank through multiple communication channels	VTB Bank

Source: Compiled by the authors.

The use cases presented in the table illustrate the versatility of artificial intelligence across multiple domains. In particular, generative AI makes it possible to analyze large volumes of financial data, uncover hidden threats and triggers, and forecast upcoming changes and trends.

When implementing the highlighted use cases, Russian systemically important banks encounter various risks and constraints that demand continuous regulatory oversight grounded in legislative and normative requirements.

Legal and regulatory governance of the banking sector's digitalization—including the deployment of artificial intelligence—is a complex, multifaceted process that must address all material risks arising from new technologies. Its primary aim is to ensure security, efficiency, and transparency in banking operations within today's digital environment. At present, the regulatory framework governing the digital transformation of Russia's banking sector, including AI adoption, remains under development. Oversight is implemented through a number of separate laws and normative acts that often overlap or even conflict with one another (Table 4).

Table 4.Regulatory Aspects of the Digital Transformation of the Russian Banking Sector

Aspect	Description
Artificial Intelligence	National strategies and frameworks for the development and regulation of artificial intelligence technologies and robotics.
Cybersecurity	Laws and regulations outlining banks' responsibilities in cybersecurity, including customer data protection, fraud prevention, and secure digital transactions.
Consumer Protection in Financial Services	Regulatory provisions ensuring the protection of customer rights and interests amid digital transformation, including service transparency, client awareness, and privacy.
Electronic Identification and Authentication	Laws governing electronic identification and authentication processes in digital banking services.
Use of Blockchain Technology	Regulations covering the use of blockchain technology in banking, including laws on digital assets and cryptocurrencies.
Antitrust Regulation	Laws aimed at preventing monopolistic concent ration in the digital banking sector and promoting fair competition.
Financial Reporting and Data Legislation	Regulations addressing banks' responsibilities in financial reporting, data storage, and information disclosure to regulators and clients.
Organization of Payment Systems	Regulations concerning the organization and operation of digital payment systems, including requirements for technical standards and security.
Privacy and Data Protection	Laws ensuring the protection of clients' personal data, g overning its collection, storage, and processing in the context of digital transformation.
Fintech Regulation	Regulations targeting the oversight of fintech companies and their interaction with traditional banks.
Technological Standards	Regulatory norms defining technological standards and requirements for banks' digital systems and services.
International Regulation	Agreements and standards governing international cooperation and interaction among banks at the global level.

Source: Compiled by the authors.

The data presented in the table highlight a critical issue: the absence of comprehensive federal laws and regulatory acts specifically governing artificial intelligence in Russia. At the same time, the implementation and use of AI technologies are increasingly exposed to various types of risks. These risks continue to grow, necessitating the development of new regulatory approaches.

The Bank of Russia plays a key role in shaping the national framework for AI regulation in the banking sector (Table 5).

Table 5: Prospective Regulatory Directions for Artificial Intelligence in the Banking Sector (Regulator's Position)

Regulatory Focus	Possible Regulatory Measures
Circulation of Anonymized Personal Data	Development and adoption of a draft law aimed at establishing procedures for anonymizing personal data by data operators who are not government authorities.
Use of Third -Party Data Processing Infrastructure	Development and adoption of legislation allowing banks to transfer information constituting banking secrecy for processing under outsourced functions involving cloud technologies.
Allocation of Liability Between the Technology Developer and the Bank	Definition of the legal status of AI -generated outputs, including in the context of intellectual property law (particularly relevant for generative AI models), and clarification of the legal framework for AI models as products of intellectual activity.

Source: Compiled by the authors based on Application of Artificial Intelligence in the Financial Market

The table outlines the key regulatory directions for artificial intelligence in the Russian banking sector that require the development and adoption of appropriate legislative measures. These directions include the regulation of anonymized personal data circulation, the use of third-party data processing infrastructure, and the allocation of liability for harm caused by AI systems.

Regulating these aspects will help ensure data security and protection, while also defining the legal framework for the use of AI in banking. This is particularly important in the context of rapidly evolving digital technologies and the growing need to ensure their safe and efficient application.

Discussion and Conclusions

The COVID-19 pandemic served as a catalyst for unprecedented change in the banking sector, accelerating digital transformation processes that might otherwise have taken decades to unfold. This period marked a point of no return, as banks moved from voluntary adoption of digital technologies to a phase of mandatory digitalization driven by external circumstances. Today, we are witnessing not merely an evolution, but a true revolution in the banking sector, where artificial intelligence, process automation, and online services are becoming the new norm. AI technologies are reshaping traditional banking products and services, making them more accessible, convenient, and secure.

An analysis of the digital maturity of Russian banks demonstrates that market leaders are not only adapting to new conditions but are actively shaping the digital landscape. Systemically important Russian banks show impressive results across key indicators, including internet presence, marketing and communications, and online sales. Their success highlights the importance of a comprehensive approach to digitalization, in which every component—from online visibility to the quality of digital customer service—plays a critical role.

The implementation of AI in banking goes far beyond basic automation. Today, AI technologies are transforming all aspects of banking operations, from credit scoring to risk management. Particularly noteworthy are use cases in personalized customer service, where algorithms can recommend solutions tailored to the individual needs of each client. One striking example of successful AI implementation is the use of chatbots and virtual assistants. Banks such as Sberbank and VTB have introduced AI-powered customer service systems, significantly reducing response times and improving customer satisfaction. Another effective use case is AI-driven credit scoring, where machine learning algorithms analyze customer data to predict creditworthiness, enabling banks to make more accurate and equitable decisions.

However, the rapid advancement of technology poses complex challenges for regulators. The current legal and regulatory framework for the digitalization of Russia's banking sector is still in development, presenting both opportunities and risks. One of the most pressing issues is the regulation of artificial intelligence, where it is essential to strike a balance between promoting innovation and ensuring safety and accountability.

A critical aspect in this area is ensuring algorithmic transparency and explainability. Both customers and

regulators must understand how decisions are made - especially in sensitive areas such as lending and fraud detection. Moreover, data protection and privacy requirements must be upheld to prevent information leaks and ensure the security of clients.

Another important regulatory consideration is the ethical dimension of AI. Systems must be designed to minimize the risks of discrimination and bias. This includes regular audits and testing of algorithms for fairness. Clear accountability mechanisms must also be established for AI-driven decisions to avoid legal disputes and regulatory uncertainty.

In summary, digitalization and the application of AI technologies in the Russian banking sector present significant opportunities for improving financial services and increasing operational efficiency. However, successful implementation requires careful attention to regulatory aspects, including transparency, data protection, ethics, and accountability. Addressing these concerns will help ensure the safe and equitable use of AI, safeguarding the interests of both clients and society as a whole.

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