Banking in the Digital Age: exploring new frontiers

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Abstract. *Nowadays, the banking industry is changing deeply because of fast progress in digital technology. Banks frequently deal with issues related to security rules, regulations, and strict systems that protect customer data and privacy. Customers now want services that fit their specific needs and preferences, making banks to invest in data analytics, artificial intelligence, and machine learning to understand customer behavior and provide customized solutions. As technology rapidly advances, banks must remain vigilant and proactive in adopting digital innovations while maintaining top security, trust, and focus on customer needs. Objective: This paper aims to show how digitalization is changing the banking sector. The main goal is to study how innovations are being integrated into banking in the context of digitalization in the Republic of Moldova. Method: To fulfil the research objectives, there were used scientific methods like analysis, synthesis, induction, deduction, and analogy. Results: Finding strategies and best practices for banks to handle digital changes, strengthen cybersecurity, deal with new threats, and keep competitive in the digital era. Originality: The research uses information from specialized literature, local articles, national laws, and regulations, and also considers external factors like geopolitical crises. This helps provide a detailed view of the challenges and opportunities in digitizing the banking sector in Moldova. The study also looks at both social-economic effects and technological progress, giving a full picture of the digital transformation in banking.*

Keywords: *digitalization, cybercrime, cybersecurity, National Bank of Moldova, banking*
JEL classification*: G21, K42, O33*

Introduction

The banking environment has become highly competitive today. To survive and thrive in this dynamic market, banks are adopting the latest technologies, which are seen as enabling resources that help develop leaner, more flexible structures capable of quickly responding to market changes. Additionally, these technologies are viewed as tools for cost reduction and effective communication with stakeholders in the banking business.

As banks integrate digital solutions into their operations, they are not only enhancing operational efficiency but also transforming customer interactions and service delivery. The rise of

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digital platforms, AI, and data analytics is driving significant shifts in how banks manage their operations, engage with customers, and respond to evolving market demands. These advancements are enabling banks to offer personalized services, streamline processes, and leverage real-time data to make informed decisions. Moreover, the increased focus on cybersecurity and regulatory compliance underscores the importance of maintaining robust digital infrastructures while navigating emerging threats.

In this context, exploring the new frontiers of banking in the digital age involves examining how these technologies are reshaping the industry, the challenges they present, and the strategies banks are employing to adapt and innovate. This study focuses on offering a comprehensive examination of these dynamics, highlighting the impact of digitalization on competitive positioning, operational practices, and customer engagement within the banking sector. The primary objective is to explore how innovations are integrated into the banking sector in the context of digitalization process in the Republic of Moldova.

1. Literature review

Digital transformation has fundamentally reshaped the banking sector, influencing everything from operational efficiency to customer engagement. According to a study by Accenture (2022), digital technologies have enabled banks to streamline operations, enhance customer experiences, and foster innovation (Gumar et al., 2023; Nguyen-Thi-Huong et al., 2023). The study emphasizes the importance of incorporating technologies such as blockchain, artificial intelligence (AI) and cloud computing into banking operations to drive efficiency and competitive advantage (Bodziony et al., 2021; Roberts et al., 2022).

The digitization of banking services has led to significant changes in how financial transactions are conducted. Research by Deloitte (2023) highlights that services such as fund transfers, account management, and bill payments are increasingly being conducted online or through mobile applications. This shift has reduced the reliance on physical branches and ATMs, allowing banks to offer 24/7 access to financial services. The study also notes that customer expectations for convenience and accessibility have driven banks to innovate rapidly in response to the growing demand for digital services (Deloitte, 2023).

As banks embrace digitalization, cybersecurity became a major concern (Shulha et al., 2022). A recent survey conducted by some experts (Natalucci et al., 2024) highlights the growing prevalence of cyberattacks targeting financial institutions. The report highlights the necessity of strong cybersecurity protocols, such as multi-factor authentication, encryption and AI-based threat detection systems. It also highlights the importance of implementing comprehensive incident response strategies to minimize the impact of potential breaches (Natalucci et al., 2024).

Digitalization has transformed customer expectations in banking. According to a report by McKinsey & Company (2021), customers now demand personalized experiences and seamless interactions across multiple channels. The research indicates that banks are leveraging data analytics and AI to deliver tailored financial products and services, enhancing customer satisfaction and loyalty. Other studies also explore the role of digital platforms in creating more engaging and user-friendly experiences for clients (Abbas, 2024; Agrawal et al., 2024).

The evolving digital landscape presents new regulatory and compliance challenges for banks. A study by the Bank for International Settlements (2024) explores how regulatory frameworks are adapting to the digital age. The report emphasizes the need for regulations that address emerging risks associated with digital banking, such as data privacy and cybersecurity. It also discusses the role of regulatory bodies in ensuring that banks adhere to standards that protect both consumers and the financial system (Bank for International Settlements, 2024).

Looking ahead, the future of banking will be shaped by ongoing advancements in technology and evolving customer expectations (Josyula, 2021; Ulrich-Diener et al., 2023). A report by PwC (2024) examines emerging trends such as the rise of fintech startups, the integration of blockchain technology, and the expansion of digital currencies. The study highlights how these innovations are likely to influence the banking sector, offering new opportunities for growth and transformation while also presenting potential challenges.

2. Methodology and data

The research employs a comprehensive methodology to investigate the role of digitalization in transforming banking practices, assessing how emerging technologies are reshaping operational efficiencies, customer experiences, and competitive dynamics within the sector. This study integrates both exploratory and analytical approaches to provide a thorough understanding of emerging trends, technologies, and their impact on banking practices.

The research begins with an extensive literature review, drawing from academic articles and international financial organizations' reports, to build a foundation of current knowledge. Key sources include reports from McKinsey & Company, PwC, and the Bank for International Settlements (BIS), among others. This foundational research is further enriched by analyzing reports from the National Bank of Moldova, which offer insights into the digitalization trends and regulatory developments specific to the Republic of Moldova.

Data analysis encompasses both qualitative and quantitative methods. Qualitative data from case studies are subjected to thematic analysis to uncover common themes and strategies. Quantitative data are analyzed using statistical methods to identify trends and evaluate correlations between technological adoption and improvements in operational efficiency and customer satisfaction.

This methodology provides a robust framework for exploring the dynamic landscape of digital banking, offering valuable insights into how banks are adapting to and thriving in the digital age, with a special emphasis on the developments and challenges within the Republic of Moldova.

3. Research results and comments

Technological innovations significantly changed the financial services industry. One of the most important changes is the wide range of digital products and services, especially those related to mobile and smartphone devices. Economist A.C. Lyons provides an overview of the impact of technological innovations on the evolution of financial products and services. Lyons compares traditional offerings with those emerging from recent digitalization, covering areas such as payments and transfers, savings and investments, borrowing and financing, and risk management (Lyons & Kass-Hanna, 2021).

Digitalization in the banking sector now allows customers 24/7 access to a wide array of services. This shift has brought increased ease and convenience to banking transactions. Importantly, digitalization has minimized human error in transactions, making transfers smoother and more streamlined. Additionally, it has simplified data management for banks and financial institutions, from recordkeeping to tracking expenses and budget planning.

Cloud-enabled systems and automation continuously record transactions, a task that was previously complex when consolidating data from both physical and online sources (Ezed, 2022).

As a result of the above mentioned, we can state that the primary benefits of digitalization for banks and financial institutions are as follows:

- Modern technologies enable process automation and data digitization, which lead to substantial cost reductions and improved operational efficiency. Examples include automating activities like opening accounts, processing loans, and detecting fraud;
- Digital transformation helps banks provide customers with personalized services and self-service options such as mobile banking, online account management, and 24/7 customer support;
- The use of advanced technologies such as biometrics and encryption enhance security of sensitive information. This is possible when clients use fingerprints or facial recognition to access their accounts, and implement end-to-end encryption for online transactions;
- Banks can rapidly develop and launch new products and services, allowing them to keep competitiveness on the market;
- Digital transformation helps banks gather and analyze large amounts of data, offering important and valuable information to take better decisions. This will require understanding customer trends and preferences, and finding potential growth opportunities;
- Technologies like artificial intelligence, machine learning and blockchain help banks remain competitive on the market;
- Digital tools like instant messaging and video conferencing enhance collaboration within organizations leading to a more efficient decision-making.

Digital transformation in the banking sector presents both significant opportunities and considerable challenges. Mobile and internet banking are key elements of this transformation, allowing customers to carry out various financial transactions.

Banking risks in the digital space are primarily categorized into two types: data security risk and cyber security risk:

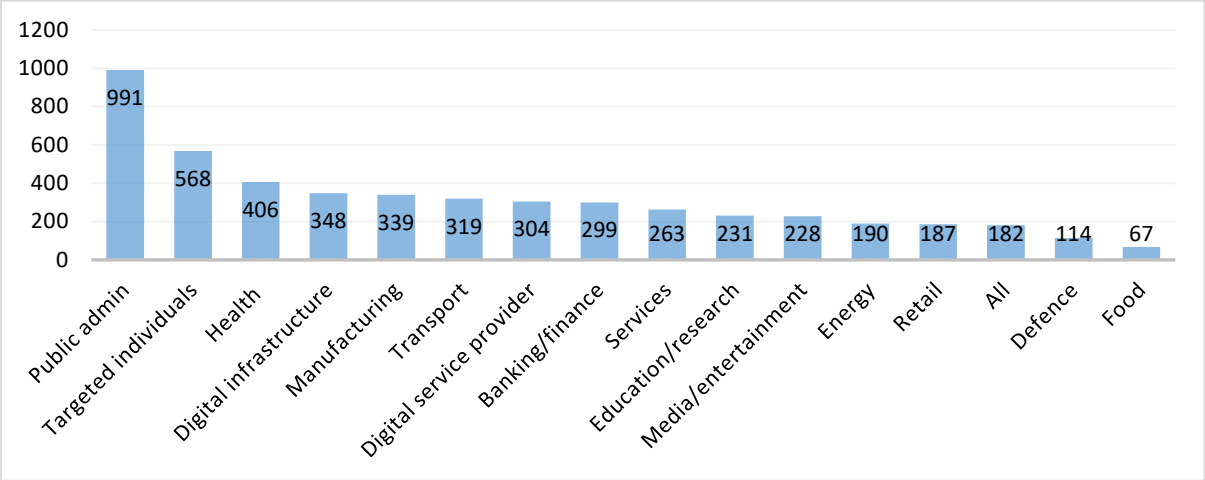
- Data security risk pertains to the protection of sensitive customer information and financial data from unauthorized access or breaches. It involves ensuring that personal and financial data stored by banks is secure from theft, loss, or misuse. Data protection measures include access controls, encryption and regular security audits to prevent unauthorized access and protect data integrity;
- Cyber security risk involves threats from malicious activities such as hacking, phishing, and other cyber-attacks targeting banking systems (European Parliament, 2022). Cyber security risks focus on the protection of digital systems, networks, and applications from attacks that could disrupt banking operations, compromise data, or cause financial losses. Measures to counter cyber security risks include firewalls, intrusion detection systems, regular software updates, and employee training on recognizing and avoiding cyber threats.

However, alongside these benefits, the risk of cyberattacks becomes a major concern. Cyber threats such as banking fraud, hacking, phishing, and the need for enhanced security awareness are significant challenges associated with the digital shift in banking (Johri & Kumar, 2023).

During the reporting period of the ENISA Threat Landscape 2023, various sectors experienced significant cyber events. Public administration (19%) and health (8%) were the most targeted, followed by digital infrastructure (7%) and digital service providers (6%), reflecting the interconnected nature of these sectors. Civil society, labeled as "targeted individuals," accounted for 11% of events, involving social engineering and information manipulation (see Figure 1).

The finance sector faced approximately 6% of the events, with ransomware emerging as the prime threat across industries. Manufacturing (14%), health (13%), and public administration (11%) were heavily impacted by ransomware, while DDoS attacks primarily targeted public administration (34%), transport (17%), and banking/finance (9%). Data-related threats, particularly those involving personal information, affected public administration (16%) and health (10%). Malware attacks were directed at targeted individuals (20%) and sectors like banking/finance (12%). Social engineering and information manipulation campaigns had a broad reach, particularly targeting the general public, public administration, and media.

Figure 1. Targeted sectors by number of incidents (July 2022 – June 2023)



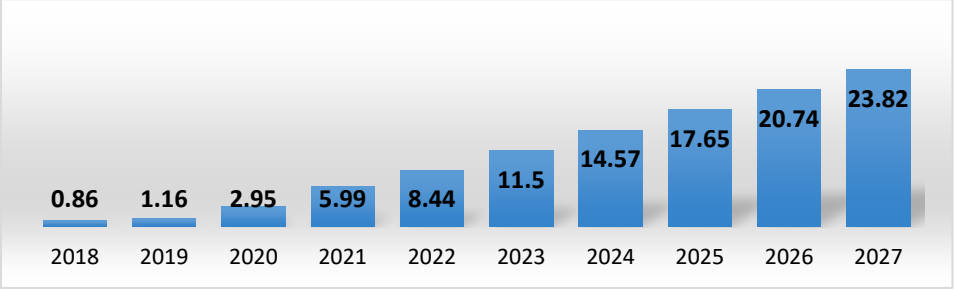
Source: elaborated by authors in base of ENISA, 2023.

Digital infrastructure, vital for many sectors, experienced threats against availability, while supply chain attacks and vulnerability exploitation mainly affected public administration and digital service providers. The overall landscape highlights the growing interdependence of critical sectors and the persistent threat posed by ransomware, DDoS attacks, and data breaches.

The rise in cyberattacks has damaged banks' reputations. Some studies (European Business Review, 2022) found that 94% of 1000 consumers surveyed in the Germany, UK, the USA and India would switch banks if their data was compromised. Additionally, 60% of consumers are cautious when choosing a bank due to fear of cyberattacks. To rebuild trust, banks must adopt advanced technologies like AI and data encryption to enhance security. According to some conducted surveys (Bischoff, 2023), the most cyber-secure countries globally include Denmark (6.72), Sweden (8.40), Germany (9.39), Ireland (9.40), and Japan (9.46), ranked by their cyberattack vulnerability scores. (European Business Review, 2022).

Banks must implement comprehensive security strategies that include advanced threat detection systems, regular vulnerability assessments, employee training, and incident response plans. Additionally, maintaining up-to-date software and security protocols, encrypting sensitive data, and adhering to regulatory compliance standards are crucial for mitigating risks and safeguarding the integrity of banking operations. By prioritizing cybersecurity, banks can better protect themselves and their customers from evolving threats in the digital landscape.

Figure 2. Estimated cost of cybercrime worldwide



Source: elaborated by authors in base of (Bank of England, 2022).

The 2022 Systemic Risk Survey indicates that 74% of respondents consider cyberattacks to be the greatest risk to the financial sector (Bank of England, 2022). Banks are particularly attractive targets

for cybercriminals due to their handling of large volumes of monetary transactions daily, which increases the potential for security vulnerabilities. According to various studies and projections, the frequency and sophistication of cyberattacks are expected to rise (see Figure 2), driven by advancements in attack techniques and the expanding digital footprint of financial institutions.

At the same time, the war in Ukraine has heightened cybersecurity risks globally (Guchua & Zedelashvili, 2023). Geopolitical instability often leads to increased cyberattacks and cyber-espionage activities, as malicious actors exploit the chaos for various objectives. This conflict has intensified threats to critical infrastructure and sensitive information, making cybersecurity a pressing concern for organizations worldwide. The increased risk of cyberattacks during such crises underscores the need for robust security measures and vigilant monitoring to protect against potential breaches and disruptions.

This imposes the urgent need for banks to improve their cybersecurity measures, adopt advanced technological solutions, and continuously update their defense strategies to mitigate evolving threats and safeguard their operations and customer data.

For the Republic of Moldova, the threat of cyberattacks is particularly relevant in the context of the ongoing war in Ukraine. According to Thales, cyberattacks on Moldova more than tripled in 2022, making it a prime target for pro-Russian hackers due to its alliance with Ukraine. Some researches (Record Media, 2024) indicates that Moldova's data and cybersecurity policies have not kept pace with the rapid growth of its digital infrastructure. However, in 2023, Moldova made a major move by passing a cybersecurity law. This law requires incident reporting, safeguards, cooperation, and network standards for all medium-sized or larger internet providers and key infrastructure entities. Drafted with help from Estonia, it will start in early 2025 (Record Media, 2024)

The substantial international support for Moldova’s cyber resilience reflects a clear recognition, especially from EU institutions and member states, that robust cyber defenses are most effective when established proactively, before a major incident occurs. Moving forward, international assistance should urgently focus on three key priorities. First, CERT-GOV-MD in collaboration with an external technical institution responsible for the coordination of international assistance in future, should develop and maintain an up-to-date list of Moldova's immediate operational needs to address in the event of a national cyber incident. This includes actions to rapidly improve cyber defense, like using private-sector incident responders. Second, "hunt forward" operations, introduced by US Cyber Command, should be carried out on Moldova’s networks. These operations involve hiring top cybersecurity companies to uncover vulnerabilities and detect attackers already present in Moldovan systems. These efforts should also contribute to long-term capacity-building activities, such as the EU’s Cybersecurity Rapid Assistance programme, to enhance Moldova’s foundational cybersecurity capabilities. (Osborne & Jarnecki, 2023). Finally, Moldova should be prioritized for participation in NATO’s Cooperative Cyber Defence Centre of Excellence (CCDCOE) exercises. Eight non-member countries, like Ukraine and Japan, already take part, gaining valuable insights into cyber threats and fostering stronger defense collaboration. Moldova’s involvement would offer another priority way to enhance its readiness.

These efforts should be supported by ongoing collaboration with Moldova’s cyber defenders. As shown by Ukraine, strong national cybersecurity relies on extraordinary local efforts. Moldova’s partners must not assume that external help alone would be enough during a major cyber incident. Effective national defense requires skilled local experts working within clear legal and organizational frameworks.

Another crucial aspect to analyze within this research theme is the evolution of the digitalization process in response to client demand for advanced services. While globally the digital transformation is evolving significantly, in the Republic of Moldova the digitalisation of the financial market is moving slower. This is due, on the one hand, to political, social and economic instability in

the newly formed country as an independent state and, on the other hand, to the lack of experience in attracting investments to implement and adapt new digital technologies according to consumer demand. With the advent of the internet, the digital transformation of the traditional economy has become mandatory, as the majority of consumers have switched to digital networks.

With the rise of digitalization in Moldova, banking operations such as fund transfers, account openings, bill payments, obtaining account statements, and accessing services like ATM cards, debit cards, credit cards, cheque books, and loan details can all be performed without going to a bank. Technology in E-banking allowed to find alternative banking practices that are performed at lower costs. According to NBM reported data, the most used payment instrument by number of transactions is the payment card, followed by credit transfer. (National Bank of Moldova, 2023). Analyzing the statistics presented by the NBM, the payment card acceptance network in the Republic of Moldova expanded throughout 2023, with the number of POS terminals increasing by 4.4 thousand units compared to the previous year, reaching a total of 36,709 POS terminals by the end of the reporting year. The number of payment cards in circulation by the end of 2023 registered 3 million 292 thousand and 564 units, and recorded a growth of 17.55% compared to the end of 2022. At the same time, by 2023, the ratio of active cards versus total cards slightly decreased to approximately 59.7% (National Bank of Moldova, 2023). This indicates a growing number of total cards that are not being activated or used.

Depending on the type of payment card technical solution, the number of proximity (contactless) cards registered an increase of 18.4 percent from the year 2022. The rapid increase in the share of these types of cards within the total number of cards in circulation has led to the gradual replacement of hybrid cards, which had previously replaced magnetic strip cards. Thus, at the end of 2023, contactless cards already held the majority (98.3 percent) of the total number of cards in circulation in the Republic of Moldova.

At the same time, the total volume of card transactions also recorded an increase at the end of 2023, constituting a total value of almost 41 billion MDL (National Bank of Moldova statistical database, 2023). Daily, with the payment cards issued in the Republic of Moldova are made an average of 84.8 thousand cash withdrawals and about 501.4 thousand to pay, and without cash. The average value of a withdrawal of cash reached the figure of 2,889 lei, an increase of 7.7 percent compared to from the year 2022. At the same time, a non-cash payment had on average the value of 332 lei, small, increasing by 1.8 percent in 2022. Number and value of cashless payments maintained an upward trend throughout the period under review. The increase in the value of cash withdrawals correlates with the increase in cash in circulation (National Bank of Moldova, 2023) (see Figure 3).

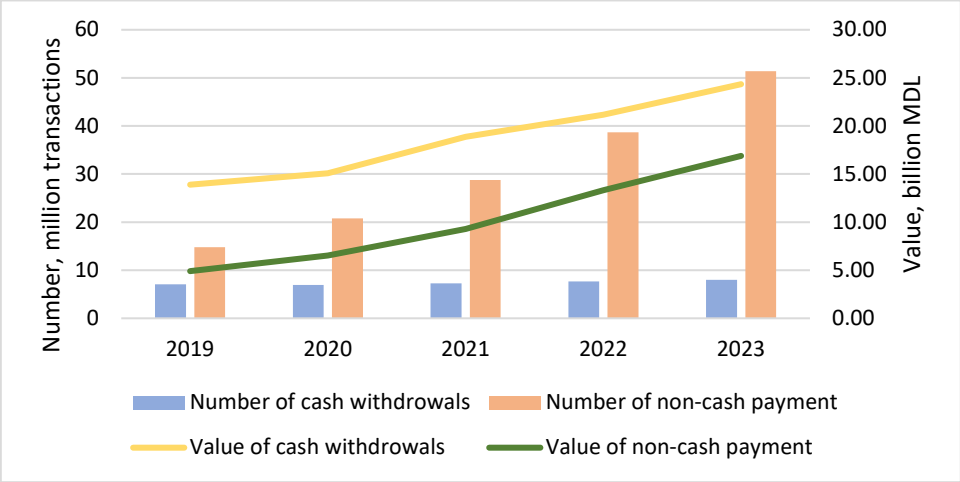
Analyzing the fluctuations in the volume of cash withdrawals transactions, it was concluded that a significant decrease occurred during the period of the Covid-19 pandemic crisis in 2020. These were the consequences of restrictions both on personal travel and on protecting health and avoiding the spread of the virus during that period. Moldovan citizens had to switch to working remotely and most banks adapted to operating customer services online.

In 2023, of the total 28.4 million payment transactions made through client-initiated credit transfers, 89.1% were conducted electronically via the Automated Remote Service System (SADD). This marks a significant increase in the digitalization of payment services in the Republic of Moldova, up from 74.4% in 2019. The number of electronic credit transfers grew by 22.8% compared to the previous year, while paper-based transfers saw an increase of 18.1% compared to 2022.

The total value of credit transfers reached 797.3 billion lei, with 90% of transactions executed electronically and 10% on paper. In 2023, 150.6 thousand direct debit transactions amounting to 163.6 million lei were recorded, representing declines of 13.5% in volume and 5.1% in value compared to 2022. By the end of 2023, the number of users of direct debit had decreased to approximately 4.1

thousand, reflecting a 12.8% drop from the previous year. These trends indicate a continuing shift towards digital payment methods, although the popularity and usage of direct debit remains limited.

Figure 3. Number and value of domestic cash withdrawals and non-cash payments during 2019-2023



Source: Developed by authors using data from the National Bank of Moldova's statistical database on the card payment system of the Republic of Moldova.

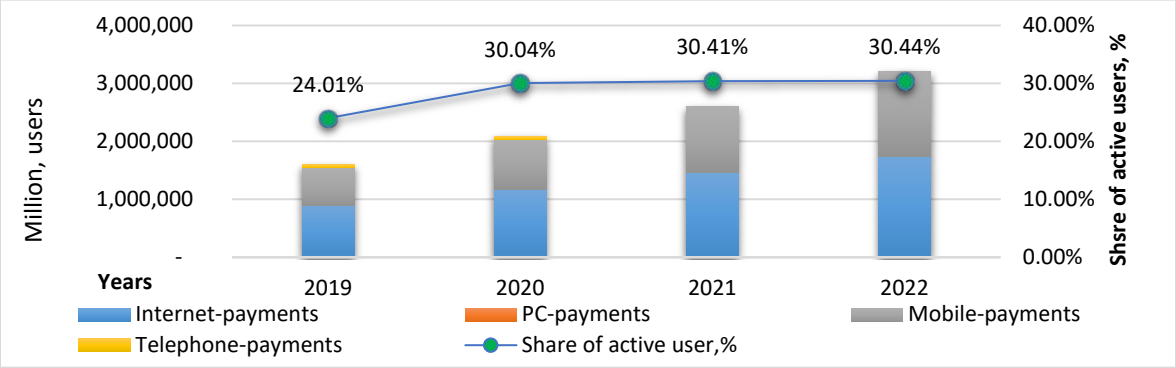
The increase in electronic credit transfers suggests that digitalization has improved the efficiency and accessibility of banking services, allowing customers to perform transactions more conveniently and quickly compared to traditional paper-based methods. At the same time, the rise in the value of electronic transactions (90% of total credit transfers) points to the strengthening of digital infrastructure and services within the banking sector, indicating that banks are investing in technology to enhance their service offerings.

Automated remote service systems (SADD) are IT solutions and/or equipment made available to account holders by payment service providers, allowing them, through a software application, an authentication method, and a communication channel, to remotely access the funds in their payment account. This access enables the user to obtain information regarding the account balance and transactions made, as well as to carry out transactions on behalf of and under the instructions of the account holder from the funds in the payment account (National Bank of Moldova, 2023).

At the end of 2023, the total number of Automated Remote Service Systems (SADD) holders reached 3.935 million, marking a 23% increase compared to 2022. Active holders also grew by 27.3%, reaching 1.2 million, indicating increasing customer interest and trust in using SADD. Active users represented 31.5% of the total SADD holders. SADD users were almost evenly split between internet-payments (50.3%) and mobile-payments (49.7%), both categories showing a 4-percentage point growth compared to 2022. In 2023, payment service providers discontinued PC-payments and telephone-payments systems.

Throughout 2023, 57.1 million transactions were carried out via SADD, a 20.6% increase from 2022, driven by customers frequently using SADD to pay for goods and services due to its convenience. The total value of transactions through SADD amounted to 989.8 billion MDL, a 5.9% increase from the previous year, with 94.2% of the transaction value attributed to legal entities (see Figure 4).

Figure 4. The total number of Automated Remote Service Systems holders during 2019-2022

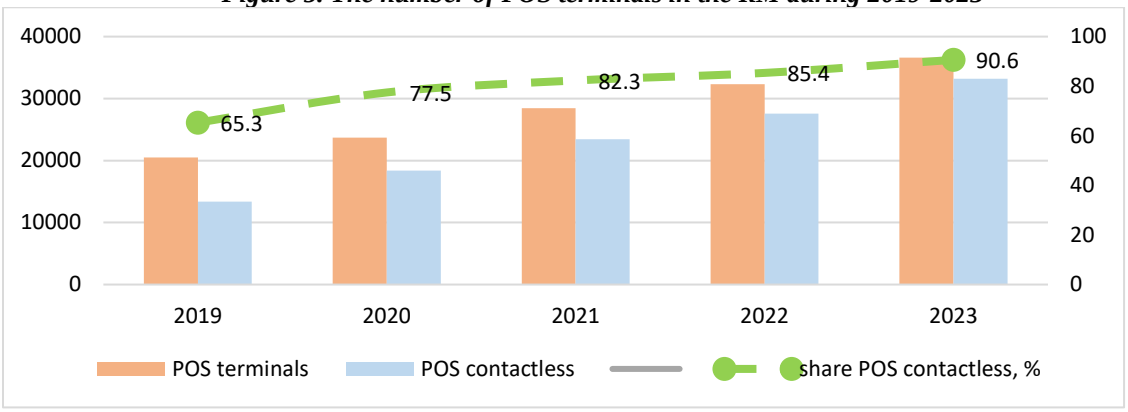


Source: Developed by authors using the National Bank of Moldova's statistical database and Annual Report series.

The increase in ARSS transactions is due to customers choosing these systems for their convenience and the lower costs payment service providers face when handling remote payments.

The total value of transactions made through Automated Remote Service Systems (SADD) by individuals and legal entities amounted to 989.8 billion MDL in 2023, representing a 5.9% increase compared to the previous year. This growth reflects a rise in customer confidence in using SADD for transactions. Approximately 94.2% of the total transaction value was carried out by legal entities. Usually, e-commerce activity is carried out following two methods of payment: online payment, cash-on-delivery (with the possibility to use POS terminals for accepting cards). Moldova's payment card acceptance network expanded in 2023, reaching a total of 39,698 POS terminals (see Figure 5).

Figure 5. The number of POS terminals in the RM during 2019-2023



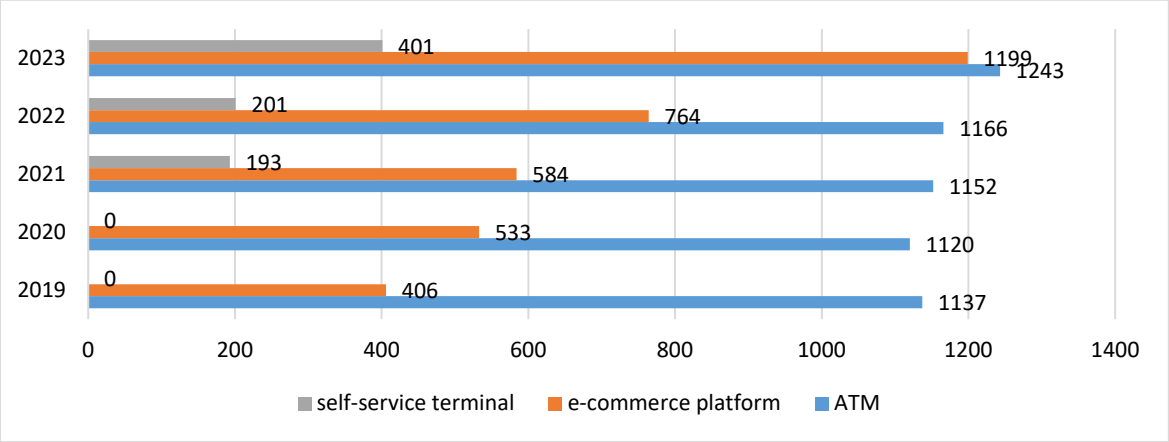
Source: Developed by authors using the statistical database and Annual Reports from the National Bank of Moldova.

The share of POS terminals contactless shows an increasing tendency in dynamics with the fluctuations in 2020. The increased usage of proximity (contactless) cards after the pandemic has driven a rise in demand for contactless POS terminals in the financial market. The evolution of digitalization, the emergence of new payment instruments on the financial market, in tandem with the impact of internal and external factors, create fluctuations in demand and supply as well. This indicates that more people are using ATMs for their banking needs, which is an important indicator of the overall health of the banking industry (Gitnux Report, 2024).

The data presented in Figure 6 highlights a steady growth in the number of ATMs from 2019 to 2023. In 2019, there were 1,137 ATMs, and by 2023, this number increased to 1,243, reflecting an

overall rise of 106 units over the four-year period. The most significant change occurred between 2022 and 2023, with an increase of 77 ATMs. This sharp rise suggests that 2023 saw a concentrated effort to expand ATM infrastructure, possibly driven by higher demand for cash accessibility or enhanced banking services in remote areas. The consistent year-over-year growth indicates a positive trend in banking infrastructure development, with an average annual increase of around 27 ATMs during this period. This expansion supports the ongoing digital transformation in the banking sector by balancing traditional cash services with modern payment technologies, catering to diverse customer needs.

Figure 6. The total number of ATMs, and e-commerce platforms in the Rep. Moldova during 2019-2023



Source: Developed by authors using the statistical database and Annual Reports from the National Bank of Moldova.

The COVID-19 pandemic the move to online shopping as people chose to avoid physical stores. Businesses adapted quickly to meet demand. The number of platforms surged by 30.7% to 763, reflecting the continued shift towards e-commerce in the wake of governmental restrictions, as businesses prioritized online sales channels.

The most significant increase occurred in 2023, with a 62.9% increase to 1243 e-commerce platforms. This exponential growth may indicate the maturity of digital ecosystems, increased consumer trust, and greater business investment in e-commerce infrastructure. Moldova's e-commerce sector is growing as internet access becomes more widespread and email use for business communication increases. An increasing number of local businesses are using social media for marketing, while access to both wired and mobile internet is improving with the growing use of smartphones. Some local operators are already planning upgrades to 5G infrastructure. Additionally, most major Moldovan banks provide online payment integration, and Internet banking is gaining popularity (International Trade Administration, 2024).

In the Republic of Moldova, the banking system model is customer-centric and the implementation of new digital products largely corresponds to consumer demand. However, often the effort put into implementing new banking products does not bring the expected profit.

Digitalization in the banking sector could reduce human involvement and and make most jobs unnecessary. Thus, the digitization of the banking sector in the Republic of Moldova is impacting both the workforce and the number of physical branches. Figure 7 illustrates the decline in the number of branches and agencies during the last years. This reduction may be attributed to the rise of online banking, leading to fewer physical locations required for traditional banking services. The significant decline of agencies, at the same time, indicates a notable shift away from traditional agency models

towards digital services. Agencies often serve as extensions of branches, and their reduction suggests that customers are increasingly relying on digital platforms for banking needs.

The number of employees has shown a gradual increase from 7,828 in 2019 to 8,517 in 2023, suggesting a slight overall growth in workforce size despite the potential for job redundancy due to digitalization. This increase in employees may indicate a shift in roles rather than an outright reduction, with a potential focus on roles that enhance digital services, customer support, and technology management. Currently, the advancements in digitalization are progressing much faster in the front office compared to the middle and back office.

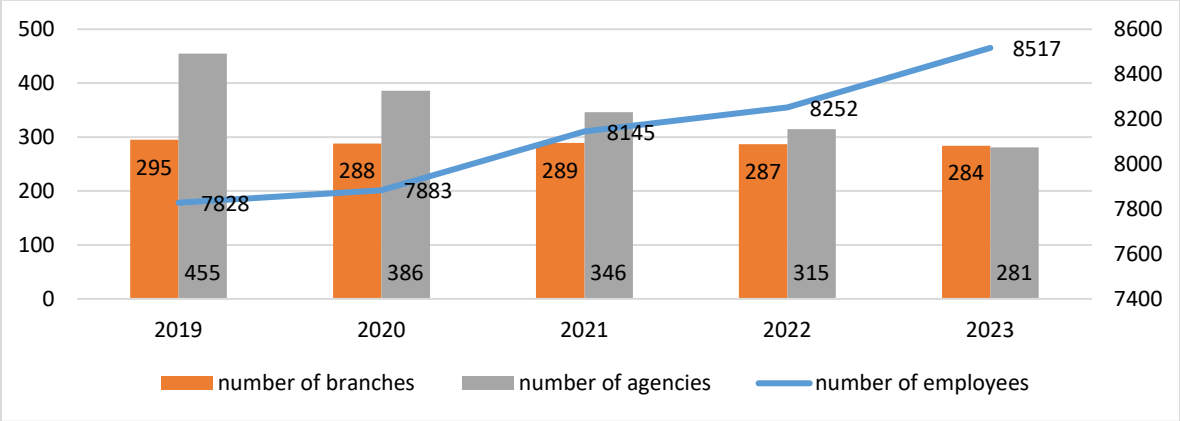
The banking sector has mostly focused its digitalization vector on customer-oriented digital channels, but missed to improve the general customer experience because many middle and back office processes are still manual and paper-based.

As the industry continues to embrace digital solutions, banks must focus on workforce adaptation, ensuring employees are equipped with the skills necessary to thrive in an increasingly automated environment. Furthermore, the reduction in physical infrastructure highlights the necessity for banks to balance digital offerings with the need for personal customer interactions, ensuring they meet the evolving preferences of consumers.

In the near future, the banking sector will offer significant opportunities for technology-related jobs, such as cybersecurity specialists, credit analysts, robot programmers, blockchain architects and process modelers, and delivery managers, which are expected to be in high demand (Meena & Parimalarani, 2020).

Like most other developing countries, Moldova faces gaps in financial inclusion and financial literacy. According to some researches, the main reasons for the low level of financial inclusion in Moldova are primarily the population's low income and lack of financial literacy, combined with the rapid pace of financial product development (Iordachi & Ciobu, 2020).

Figure 7. The total number of branches and employees in the banking sector of the Rep. Moldova during 2019-2023



Source: Developed by authors using the National Bank of Moldova's statistical database and Annual Reports

Compared to banks in EU countries and banks that are only digital, the banking sector in Moldova performs less effectively in online services. As digital banking continues to expand, Moldovan banks must improve their offerings to remain competitive against these rivals.

Despite the challenges, the Republic of Moldova has great potential to become an innovation-driven economy. The country is currently ranked 56th among the 132 countries surveyed by the Global innovation index in 2022 (Global Innovation Index Database, WIPO, 2022). The Republic of Moldova continues to be a record holder, achieving Innovation Achievers status for a 12th consecutive year. The

growth of cashless transactions and widespread use of bank cards has driven the introduction of various electronic banking products and services, including internet banking, mobile banking, SMS banking, ATMs, and POS terminals. An analysis of remote banking services reveals that all licensed banks in the Republic of Moldova now provide a comprehensive range of digital banking options to their customers (Iordachi & Ciobu, 2021).

Moldova registers a high gross secondary enrolment rate of 86%, a strong indicator compared to other Low- and Middle-Income Countries (LMICs). This reflects a foundational level of education and essential competencies in mathematics and language skills, which are crucial for developing further capacities in the IT sector. Businesses and financial institutions may need to adapt their strategies to accommodate the rising demand for non-cash payment solutions, including enhancing digital infrastructure and security measures. Policymakers and regulators may also need to monitor these trends to ensure the resilience and integrity of the financial system amidst the evolving payment landscape.

The analysis of global digital banking trends highlights several key innovations that are expected to influence the Moldovan market. Personalized products and services have become a major focus, with big data, artificial intelligence, and machine learning enabling banks to offer tailored experiences to customers. AI-driven targeted services are also gaining traction, as real-time AI bots collect customer preferences and help banks provide personalized and predictive services.

Cloud computing is another significant trend, providing benefits such as cost efficiency, scalability, and enhanced security, making it a cornerstone of digital banking innovation. Security and privacy are vital as customers increasingly expect strong cybersecurity measures to safeguard their assets and data online. Lastly, user-friendly interfaces and multifunctional mobile banking apps are now essential, as customers prioritize convenience and intuitive design in their banking experiences. These trends reflect the evolving landscape of digital banking globally (Tymoshchuk, 2023).

Digital transformation in the banking sector presents great opportunities but also comes with significant challenges. Mobile and internet banking have simplified financial transactions, offering convenience to customers. However, these advancements also increase the risk of cyberattacks, making security a major concern. Threats such as banking fraud, hacking, phishing, and the need for greater security awareness are key challenges that accompany the shift to digital services in the banking industry (Johri & Kumar, 2023).

Implementing advanced technologies can significantly enhance a bank's ability to defend against threats and protect sensitive information. The most common digital solutions that can help mitigate cybersecurity risks are:

- Advanced Threat Detection Systems: utilizing machine learning and artificial intelligence can help detect and respond to threats in real-time. These systems analyze patterns and anomalies in network traffic to identify potential security breaches and prevent attacks before they escalate;
- Multi-Factor Authentication (MFA): MFA improves security by requiring users to confirm their identity through multiple steps before accessing accounts or systems. This significantly reduces the risk of unauthorized access, even if login credentials are stolen or compromised;
- Encryption: encrypting data ensures that sensitive information is protected both at rest and in transit. Strong encryption protocols safeguard financial transactions and personal data from unauthorized access, making it significantly harder for attackers to exploit;
- Automated Incident Response: digital solutions can automate the response to security incidents, such as isolating affected systems, notifying relevant personnel, and initiating predefined response actions. This helps minimize damage and recover more swiftly from attacks;
- Cloud Security: cloud-based security solutions offer scalable protection, including secure data storage, threat monitoring, and disaster recovery. Cloud providers often have advanced security measures in place, which can enhance the overall security posture of banks;

- Regular Security Updates and Patching: digital solutions enable automated updates and patch management to address vulnerabilities and keep systems secure. Regular updates ensure that software and systems are protected against the latest threats;
- Employee Training and Awareness Programs: digital platforms can provide ongoing training and simulations to help employees identify and respond to phishing attempts and other social engineering tactics. Enhancing employee awareness helps prevent human error, which is a significant factor in many security breaches;
- Behavioral Analytics: implementing behavioral analytics tools can help identify unusual activity patterns that may indicate a security threat. By monitoring and analyzing user behavior, banks can detect anomalies that could signify potential breaches or fraudulent activity.

By leveraging these digital solutions, banks can strengthen their cybersecurity defense, enhance their ability to respond to threats, and better protect their customers' sensitive information. To effectively tackle these cybersecurity challenges, banks will need to invest in several key areas:

- Allocating significant resources towards advanced cybersecurity technologies, such as AI-driven threat detection systems, robust encryption protocols, and automated incident response solutions. These technologies are essential for detecting, preventing, and mitigating cyber threats;
- Implementing and maintaining cutting-edge cybersecurity measures require substantial financial investment. Banks must budget for both the initial costs of acquiring technology and ongoing expenses related to system upgrades, monitoring, and maintenance;
- Skilled cybersecurity professionals are critical for managing and responding to security threats. Banks will need to invest in hiring and training experts in cybersecurity, data protection, and IT risk management. Continuous professional development will be necessary to keep pace with growing threats and technologies;
- Comprehensive training programs for employees at all levels are essential to ensure they recognize and respond appropriately to cyber threats. Regular awareness campaigns and simulations will help minimize human error, a major factor in many security breaches;
- Banks must develop and enforce stringent cybersecurity policies and practices in line with regulatory requirements. This includes ensuring compliance with industry standards and regulations related to data protection and cybersecurity;
- Engaging in partnerships with cybersecurity firms, industry groups, and regulatory bodies can provide valuable insights, resources, and collaborative solutions for tackling cyber threats;
- Developing and updating on a regular basis incident response and disaster recovery plans will be crucial for quickly addressing and recovering from cyber incidents, minimizing potential damage and operational disruption.

By investing in these areas, banks can create a strong cybersecurity framework capable of defending against advanced threats and safeguarding their operations and customer data. For developing countries like the Republic of Moldova, implementing advanced cybersecurity measures presents several challenges. Limited financial resources are a significant barrier, as the cost of acquiring, implementing, and maintaining sophisticated cybersecurity technologies can be prohibitive. Additionally, there is often a lack of skilled cybersecurity professionals, which makes it difficult to recruit, train, and retain talented persons capable of managing complex security systems and responding to threats.

Infrastructure limitations also pose problems, with outdated IT systems and inadequate internet connectivity affecting the effectiveness of security measures and the ability to integrate new technologies. Developing countries may also struggle with establishing and enforcing comprehensive cybersecurity regulations and standards, leading to inconsistent practices and protection gaps. A lack of awareness and education about cybersecurity risks and best practices can contribute to vulnerabilities, as both businesses and individuals may not fully understand potential threats or how to

mitigate them. Economic instability can further complicate matters by affecting the prioritization of cybersecurity investments, leading to fluctuating budgets and reduced capacity for long-term planning. Limited access to global cybersecurity expertise and resources can also be a challenge, making it difficult to stay updated with international best practices and technologies. Additionally, political instability or geopolitical tensions may impact the ability to implement and enforce effective cybersecurity measures, potentially exacerbating security concerns. Addressing these challenges will require a coordinated effort from both the government and private sectors. Strategies may include seeking international assistance and partnerships, investing in local talent development, focusing on key areas for cybersecurity improvement, and gradually enhancing infrastructure and resources to build overall security resilience.

Conclusions

The adoption of digital technologies has enabled banks to develop leaner and more flexible organizational structures. By streamlining operations and automating routine tasks, banks can react faster to market changes and customer demands. This agility is essential in maintaining a competitive edge in a highly dynamic market.

Digitalization has significantly transformed customer expectations and interactions with banks. Customers now demand seamless, personalized experiences across multiple channels. Banks leveraging data analytics and AI are better positioned to meet these expectations, offering tailored financial products and services that enhance customer satisfaction and loyalty.

As banks embrace digitalization, the need for strong cybersecurity measures cannot be overstated. The increasing prevalence of cyberattacks highlights the need for advanced security protocols, including encryption, multi-factor authentication, and AI-driven threat detection. Moreover, regulatory frameworks must evolve to address these emerging risks, ensuring that banks comply with standards that protect both consumers and the financial system.

The rise of fintech start-ups, the integration of blockchain technology, and the expansion of digital currencies represent significant trends shaping the future of banking. These innovations offer new opportunities for growth and transformation but also pose challenges that require careful navigation. Banks must adopt strategies to effectively integrate these technologies, fostering innovation while managing associated risks.

The digitalization process in the Republic of Moldova illustrates both the potential and challenges of transforming banking practices in a specific regional context. Analysis of Moldovan banks reveals how local institutions are adapting to new technologies, addressing cybersecurity threats, and navigating regulatory developments.

To remain competitive in the digital age, banks must prioritize the continuous adoption and integration of advanced technologies. This involves not only investing in digital infrastructure but also fostering a culture of innovation and agility. Banks should collaborate with fintechs, regulators, and other stakeholders to create an ecosystem that supports sustainable growth and resilience.

The digital age presents a new frontier for banking, characterized by both opportunities and challenges. By embracing digitalization, enhancing cybersecurity, and staying attuned to emerging trends, banks can thrive in this evolving landscape, delivering superior value to their customers and stakeholders.

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