Finance and Business Economics Review

Vol. 10, No. 3, September 2026, pp. 50-68
DOI : 10.58205/fber.v10i3.2143

Trends in the Use of Artificial Intelligence for Enhancing Banking Service Performance amid Digital Transformation: A Study of Selected Banks

Kerbache Hadia[1], Douffi Garmia [2]

1 Laboratory for Studies of Economic Diversification Strategies for Achieving Sustainable Development kerbache.hadia@centre-univ-mila.dz

2 Laboratory of Finance, Banks, and Business Management (University of Mohamed Khider - Biskra) - University Center Abdelhafid Boussouf – Mila g.douffi@centre-univ-mila.dz

Article Information

Article history
Received: 10 June 2025
Accepted: 24 september 2026
Published: 30 September 2026

Corresponding Author
Kerbache Hadia
kerbache.hadia@centre-univ-mila.dz

Copyright © 2026, University of Abdelhafid Boussof, Mila. This is an open access article under the CC BY-NC-ND license.

Suggested Citation
Kerbache, H. (2026). Trends in the Use of Artificial Intelligence for Enhancing Banking Service Performance amid Digital Transformation: A Study of Selected Banks, Finance and Business Economics Review, Vol. 10, No.3, pp. 50-68.

DOI : 10.58205/fber.v10i3.2143

Abstract:

This study aims to examine the role of artificial intelligence in improving banking service performance within the context of digital transformation through a comparative analysis of leading international banking experiences. The study adopts a descriptive-analytical approach supported by a comparative case study design, relying on documented secondary data, including reports published by international financial institutions and the annual reports of the selected banks. The analysis focuses on the experiences of Bank of America and Intesa Sanpaolo, together with data from the European Banking Authority EBA, to assess the impact of AI applications on operational efficiency, service quality, risk management, and regulatory compliance. The findings indicate that the effective integration of AI significantly enhances banking performance and strengthens competitive advantage. The study further reveals that successful AI adoption depends on the availability of advanced digital infrastructure, qualified human capital, and supportive regulatory frameworks. Accordingly, the study recommends increasing investment in digital infrastructure, developing specialized human competencies, and improving regulatory frameworks to support sustainable digital transformation in the banking sector.

Keywords: Artificial Intelligence, Digital Transformation, Banking Services, Operational Efficiency, Risk Management

1. Introduction

The banking sector is undergoing an unprecedented radical transformation thanks to technological advancements. Digital transformation, with its advanced technologies, highlights artificial intelligence as one of the most important technical tools that have revolutionized the way banking services are provided. This is achieved through its application in various fields, including risk assessment, customer behavior analysis, improving customer service response, and automating operational processes. However, this trend, despite its positive outcomes, is not without structural and institutional challenges that require addressing from a comprehensive strategic and organizational perspective. Despite the rapid expansion in the application of artificial intelligence technologies within the digital transformation strategies of banks, this adoption raises a fundamental question about its effectiveness and the readiness of banks in terms of infrastructure.

1.1. *Research Problematic*

Given that banking service performance encompasses multiple dimensions, including operational efficiency, service quality, customer experience, risk management, cost reduction, and competitive advantage, and considering the growing role of artificial intelligence in supporting digital transformation within the banking sector, this study seeks to address the following main research question:

To what extent does artificial intelligence contribute to enhancing banking service performance within the context of digital transformation?

1.2. Research Hypotheses

To answer to the research problem, the following hypotheses have been developed:

- The effective integration of artificial intelligence into digital transformation strategies significantly enhances operational efficiency and strengthens banks' competitive and credit positions.

- Technological infrastructure constraints, shortages of specialized expertise, and incomplete regulatory frameworks constitute significant barriers that limit the effective adoption and full realization of artificial intelligence applications in the banking sector..

- Regulatory and legislative disparities across financial markets hinder the expansion and adoption of advanced artificial intelligence applications.

1.3. Research objectives

This study is focused on achieving the following objectives:

- To analyze the mechanisms through which artificial intelligence contributes to enhancing the dimensions of banking service performance, particularly by reducing operational costs, accelerating transaction processing, and improving credit risk and fraud management

- To explore and identify the economic, regulatory, and structural barriers (such as legacy IT systems and privacy concerns) that banks encounter when adopting these advanced technologies..

- To conduct a comparative analysis of the selected banks and derive key insights from their experiences in implementing artificial intelligence to propose practical recommendations for improving banking performance.

1.4 Literature review

1.4.1. Literature on the Impact of Digitalization and AI on Operational Efficiency and Risk Management :

- (Mohit , Mohit , Anshu , Kamal, Anshul , & Sudha , The Impact of Artificial Intelligence on the Banking Sector, 2024) There is a discernible trend away from conventional approaches and toward the use of artificial intelligence, Although AI did not first debut in the financial industry until the late 1990s, after 2011 it has advanced quickly, Blockchain, cloud computing, and artificial intelligence have been progressively incorporated into Indian bank's conventional operations by cutting

down on printing and paper waste, artificial intelligence has helped Malaysian banks save money in 2023. However, the study demonstrated that because banks have not yet fully embraced the AI revolution, they still have a considerable need for human elements.

- (He , Huang , Cheng , Liang , & Liu , 2024) Digitization and artificial intelligence have led to increased operational efficiency and upgraded risk management mechanisms. The Jiangsu Bank's experience serves as a practical model where the bank relied on the Moonlight Treasure Box system, supported by artificial intelligence using facial recognition and natural language processing technologies. These efforts resulted in a significant improvement in asset quality, with the non-performing loan ratio decreasing to 0.94%, the total non-performing loans decreasing by 0.35 billion yuan, and the overdue loan ratio decreasing by 0.15%. Conversely, the reserve coverage ratio increased to 362.07%.

1.4.2 Literature on Structural Obstacles and Regulatory Challenges in Emerging Economies vs. Global Banks:

- (Ford & Elisa , 2019) The global banking industry is undergoing a rapid digital change, Indonesian banks have embraced artificial intelligence with having introduced chatbots to customize services, fraud detection systems, and predictive analytics to improve security, but there are still issues such as inadequate infrastructure, difficulty in integrating traditional systems with digital ones, high investment costs, and a dearth of specialized skills in contrast to multinational banks like Citibank, JPMorgan, HSBC, and Bank of America that have effectively improved performance through artificial intelligence.

- (Tajudeen & Rofiat , 2024) Artificial intelligence enhances the operational efficiency of banks by automating processes and analyzing risks, thereby reducing costs and improving customer experience through chatbots and intelligent analysis. It also helps in predicting financial trends, but it faces challenges related to digital infrastructure, data trust, and the underdeveloped regulatory framework in emerging economies. It pointed out its impact on restructuring banking jobs and the necessity of upskilling employees.

1.4.3 Literature Communication Quality, and Corporate Reputation in Digital Banking:

- (Feras , Samar , Mahmoud , & Abdul , 2023) It has been shown that the ability of artificial intelligence to solve problems and the quality of communication are factors that significantly contribute to and positively affect user satisfaction, as digital banking services supported by artificial intelligence meet customer expectations when their performance matches what is expected.

- (Francesca , Paola , & Antonella , 2021) Digitalization is not just a tool for improving efficiency; it is an essential element in building corporate reputation, managing risks, and linking digitalization with banking reputation. It helps banks make strategic decisions regarding digital transformation as a tool to enhance market trust and competition.

Although the literature on artificial intelligence in the banking sector has expanded considerably, most previous studies have focused on isolated dimensions, such as operational efficiency, customer experience, or risk management, or have been limited to single-country or individual case analyses. Moreover, studies providing an integrated assessment of the interplay between operational efficiency, regulatory compliance, digital infrastructure readiness, risk management, and competitive advantage within the context of digital

transformation remain scarce.This study addresses this gap by conducting a comparative analysis of selected international banking experiences to provide a comprehensive understanding of the key factors that determine the successful integration of artificial intelligence in enhancing banking service performance.

1.5.Research Methodology:

This study adopts a descriptive-analytical approach, supported by a comparative case study design of leading international banks that have integrated artificial intelligence into their digital transformation strategies. The analysis is based on documented secondary data, including official reports issued by international financial institutions, annual reports of the selected banks, and recent academic literature. The study examines the impact of artificial intelligence applications across key dimensions of banking service performance, including operational efficiency, service quality, risk and fraud management, regulatory compliance, competitive advantage, and digital infrastructure readiness. A comparative analysis is conducted to identify best practices and the major challenges associated with AI adoption in the banking sector.

The case studies were selected using purposive sampling to represent leading banking models in the adoption of artificial intelligence within digital transformation strategies. Bank of America was selected as a leading example of AI-driven intelligent automation and customer experience enhancement, while Intesa Sanpaolo was chosen as a pioneering European bank in applying artificial intelligence to regulatory compliance and banking regulatory analysis. In addition, the European Banking Authority (EBA, 2024) report was used to provide comprehensive sector-level data on the current status and trends of AI adoption across European banks, thereby strengthening the comparative analysis and facilitating the identification of best practices

2. Theoretical Framework

2.1. Digitalization technologies in modern banking:

Digital transformation in banks is considered a product of the technological revolution, characterized by rapid proliferation and the innovation of digital services and radical changes that have altered traditional banking operations (Riris , Wahyu , & Wahyu , 2022, p. 3), it transformed its tasks into easier and more flexible tasks thanks to modern digital technologies such as blockchain and artificial intelligence in banking operations.

The concept of "artificial intelligence system" according to Article 12 of the EU Artificial Intelligence Act refers to advanced technical systems programmed to operate with varying degrees of autonomy and self-adaptation with the potential for evolution and characterized by their ability to infer outputs such as predictions, recommendations, or decisions based on the inputs they receive (European Union, 2024) It relies on machine learning (Machine Learning - ML) (AI/ML) in all the bank's backend and frontend operations and includes technologies such as: credit analysis, trading activity management, pricing model design, regulatory capital planning, liquidity requirement identification and management, fraud detection and prevention, anti-money laundering and counter-terrorism financing (AML/CFT), chatbots to enhance customer experience, and support for marketing strategies (Bank for International Settlements BIS, 2024, p. 7), According to what the Economic Cooperation Organization says "An AI system is a machine-based system that, for a given set of human-defined objectives, makes predictions, recommendations, or decisions influencing real or virtual environments." (OECD), and designed to align with diverse environments where these systems must be clear and compliant with international standards to ensure legal and global compatibility, and be flexible to keep up with technological advancements, by using artificial neural networks (ANN) for data analysis and decision-

making, and employing robotics and automation to perform repetitive mechanical tasks with high efficiency (Pragma, 2024, p. 7)In the interaction with human language and in understanding and analyzing visual data we have biometric technology works on the unique identification of individuals through their biological traits such as fingerprints, retina patterns, facial features, and even DNA which allows it to eliminate the need for PIN codes and passwords and as well facial recognition technology (Bhagyashree , 2018, p. 3) And what enhances the security in its use is that biometric credentials cannot be lost, stolen, or forgotten, and it is difficult for them to be socially manipulated or shared by others (Happiest Minds Technologies, 2023, p. 10) Natural Language Processing (NLP) helps in using virtual assistants and AI-powered chatbots as an alternative to customer service representatives, as these systems rely on machine learning techniques to improve interaction with users (IDRBT Institute for Development and Research in Banking Technology, 2020, p. 24) Thus, artificial intelligence contributes to providing automated digital consultations and analysis, which reduces the need for human resources and increases the efficiency of banking operations (Phuong , Thi , & Nga , 2023, p. 18).

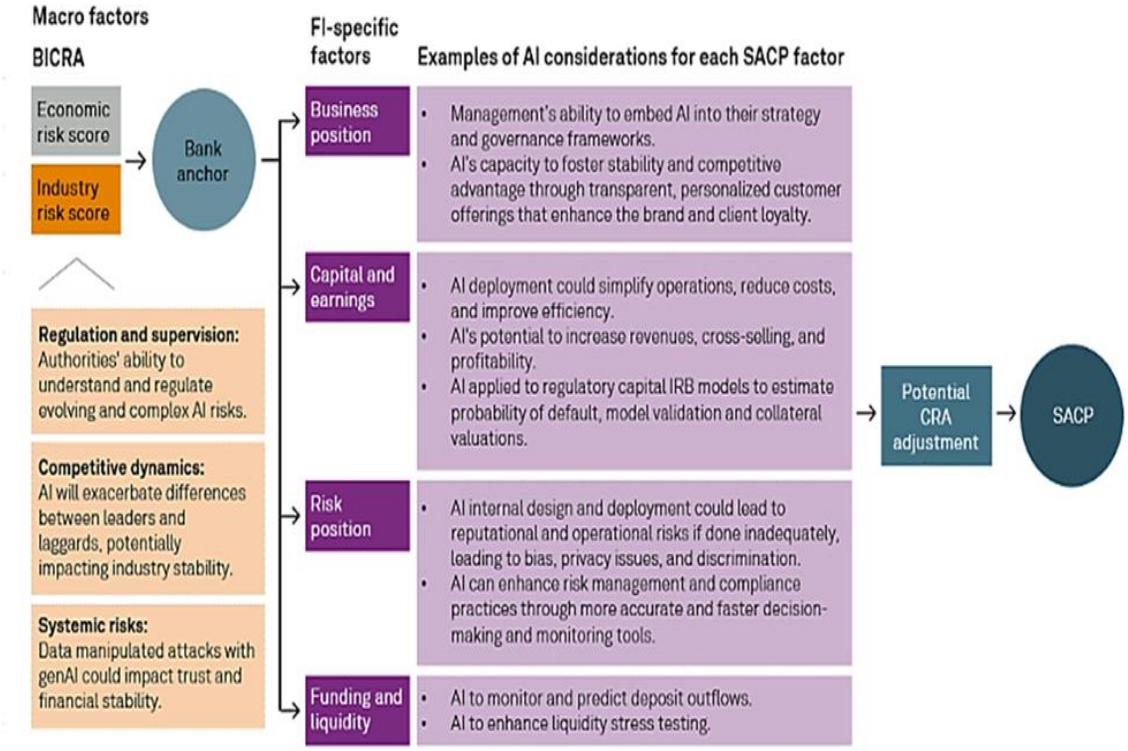
2.2Concept and Measurement of Banking Performance

Banking performance refers to a bank's ability to achieve its objectives efficiently and effectively through the optimal use of available resources, timely execution of activities, and cost minimization. It is a multidimensional concept that varies according to stakeholders' perspectives. From a managerial perspective, it is reflected in profitability and competitiveness; from an employee's perspective, it relates to the quality of the work environment; and from a customer's perspective, it is associated with the quality of services provided and customer satisfaction. Banking performance measurement serves as a managerial and control tool that evaluates the extent to which a bank achieves its objectives. It guides employees' behavior, motivates them to improve performance, supports managerial decision-making, and contributes to enhancing the overall efficiency, effectiveness, and competitiveness of banking institutions. (Chenini & Jarboui , 2018)

2.3. Banks' creditworthiness and artificial intelligence's effects :

AI strategies are a pivotal element in enhancing banking competitiveness, as their flexible deployment improves the quality of operational decisions by enhancing the quality of employee decisions, maximizing returns, and reducing costs through smart automation. This variation in potential outcomes between institutions is a factor that affects the evaluation of the bank's commercial position, and generative artificial intelligence serves as an additional catalyst to accelerate technological updates and reduce risks associated with outdated infrastructure. According to S&P Global estimates, a 10% reduction in employee-related costs could increase the return on equity by approximately 100 basis points and improve the cost-to-income ratio by about 3 percentage points, based on a sample of the top 200 global banks (S&P Global, 2024)

Fig.1. artificial intelligence on the creditworthiness of banks



Source . (S&P Global, 2024)

2.3. Artificial intelligence and digital transformation's difficulties and barriers :

With the rapid advancement of digitization and the use of artificial intelligence in the banking sector, and given the novelty of introducing these technologies, the implementation of advanced digital services as part of the business strategy does not necessarily guarantee their success, as they face various challenges that may lead to their failure (Sofiane , Benziane , Abdelhak , Salwa, Ramzi , & Youcef , 2023, p. 2) And now, a new regulatory framework is being developed to address all the challenges related to artificial intelligence topics that we mention:

Table 1. AI Challenges

Themes Related to AI Challenges	**Brief Description**
AI-driven automation could result in obsolescence of some skills	There are concerns that AI-based banking systems could change the nature of existing jobs and make some skills obsolete, resulting in job losses. Consequently, it might be a major challenge to ensure user acceptance of AI in banks.

Privacy violation concerns	The capability of most banking AI systems is enabled by amassing and analyzing vast volumes of customer-related data, including demographics, expenditure patterns, physical contact, credit card and debit card details, social media profiles, and so on. In turn, the privacy and safety of consumers is at stake when using AI.
Deprivation of creativity and adaptability	Overdependence on AI to automate decision-making and problem-solving processes could erode creativity and adaptability among employees.
Restrictive AI implementation and operational resources	The costs of implementing and operating a large-scale AI system would be extremely restrictive, especially for small banks with limited resources at their disposal. Other than the initial costs, competent data science talent would be required to sustain efficient and effective AI technology operations.
Potential digital divide	Customers who may be lacking modern personal devices (such as PCs, smartphones and tablets), Internet connectivity, and ICT skills may not be able to take advantage of banking AI systems. People of lower socio-economic statuses may be rendered incapable to exploit banking AI.
Lack of adequate quality datasets to train and test AI algorithms	Most AI technologies require vast volumes of structured, semi-structured and unstructured datasets, which might not be always available.
Loss of emotional "human touch"	AI cannot wholly replace human bankers and branch networks. The roles of human bankers should be rediscovered to foster close banker-customer contact.
Integrating AI with conventional banking processes	Currently, there is little evidence concerning how to effectively align AI and conventional banking processes. Consequently, it may not be possible to realize maximum value from AI implementation.

Source. based on. (Ghandour, 2021, p. 1584)

Obstacles to Digital Transformation in the Banking Sector: In a 2024 report by McKinsey & Company, based on a global survey that examined digital strategies in the banking sector, based on a global study of digital strategies in banks, the failure of digital transformation is often linked to three main factors: continued reliance on outdated infrastructure, partial implementation of the transformation that leads to the operation of dual systems, and misinvestment of modern tools. Together, these factors lead to poor operational efficiency and declining strategic performance: (McKinsey, 2024)

- Reliance on Outdated and Inefficient Technical Infrastructure: In this scenario, the data architecture has not undergone any real modernization, leaving what is known as "spaghetti architecture". The continued use of legacy tools and platforms hinders efficiency and innovation.

- 2. Fragmented Data Architectures between Old and New: Here, banking institutions begin transformation processes but fail to reach completion. As a result, they are forced to manage two platforms simultaneously (old and new) which increases complexity, operational costs, and weakens integration.

- Technically Limited Transformation Due to Poor Execution: In this pattern, technical transformation steps may be completed, but weak utilization of modern tools and platforms whether due to underuse or misuse leads to the loss of the intended impact and the expected competitive advantage.

3. Pratical farme work

3.1. The experience of global banks in integrating artificial intelligence into banking services:

3.1.1. American experience :

Table2 . Examples of AI-Enabled Banking Applications in the U.S. Banking Sector

AI Banking Apps	Key Features:	Available Platforms	Download	Ratings
Chime	AI-driven Neobank. ➢ Helps users maintain healthy financial habits. ➢ Tracks spending using AI and provides financial insights. ➢ Round-up saving: Automatically deposits leftover change into savings or investment accounts.	Android / iOS	+10M	**4.8**
M1 finance	AI-powered robo-advisor ➢ Builds and manages investment portfolios based on user risk tolerance and goals. ➢ Smart algorithms: Automatically rebalance portfolios. ➢ Smart Transfers: Invests excess income automatically.	Android / iOS	+1M	**4.5**
Ally	AI-powered virtual assistant by Ally Bank ➢ Uses Natural Language	Android / iOS	+1M	**3.5**

	Processing (NLP) to understand and answer user queries. ➢ Allows users to access financial data, perform transactions, and receive personalized responses. ➢ Enhances app navigation through AI-driven interactions.			
T Simple	AI-based budgeting and financial planning app. ➢ Analyzes spending habits to provide personalized recommendations. ➢ Supports saving, budgeting, and achieving financial goals. ➢ Learns user behavior to optimize financial wellbeing.	Android / iOS	+1M	**3.1**
Qapital	AI-powered savings app ➢ Combines AI and behavioral science to promote better saving habits. ➢ Lets users set custom savings goals and rules. ➢ Spare change roundup: Automatically rounds transactions and saves the difference. ➢ Analyzes spending patterns to suggest cost-cutting strategies.	Android / iOS	+500K	**4.4**

5. Conclusion

The conclusion of the research

FBER 58

ch source.Prepared by the researcher based on. (Pamarthi, 2024, p. 17)

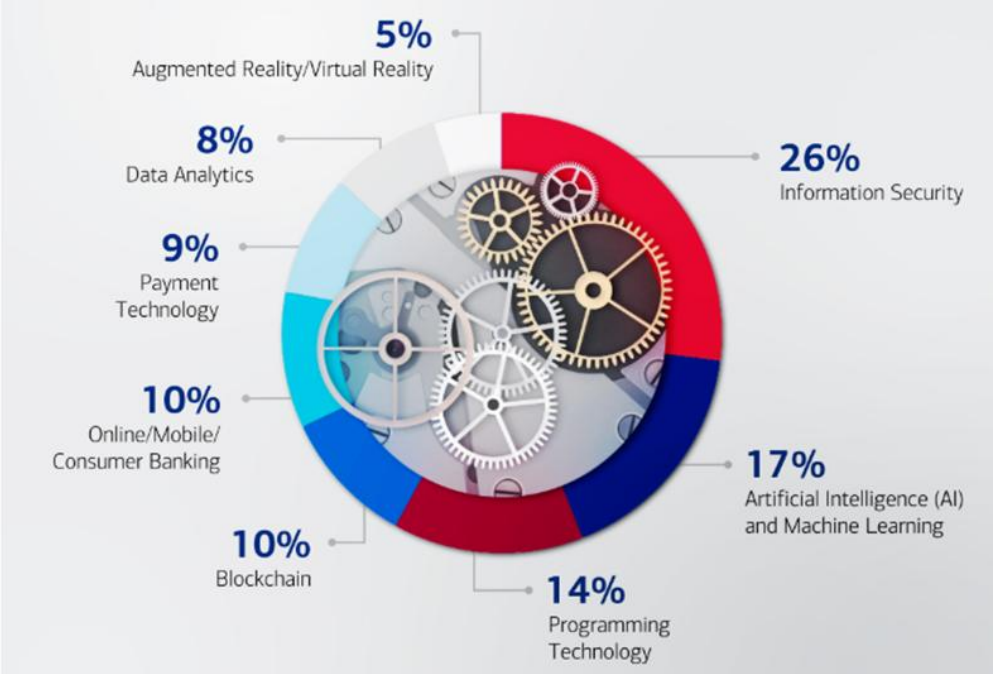
All five applications mentioned are powered banking applications launched and operating in the USA Although Qapital first originated in Sweden, it is currently managed entirely from the United States and relies on licensed American banks such as Lincoln Savings Bank.

A. Bank of America's experience in using artificial intelligence : In light of the rapid digital transformations, artificial intelligence has become a strategic tool used by major financial institutions to improve operational efficiency and customer experienceBank of America is one of the most prominent models that has employed this technology on a large scale within its various banking activities

Bank of America developed its Intelligent Receivables system to process accounts receivable through artificial intelligence predictions. This system aims to link payments with open

invoices, utilizing advanced technologies to capture data from multiple sources, including digital and paper channels, as well as emails. This innovation has helped reduce the costs associated with manual processing and accelerate revenue collection. This system was recently launched in the Brazilian market to serve a customer base in their various languages. Data indicates a 50% increase in the number of processed invoices over one year, reflecting its growing effectiveness and positive impact on the operational efficiency of companies. (BofA Bank of America, 2022).

Fig2. BofA patent granted in the first half of 2024



Source. (Bank of America BofA, 2024)

The displayed data indicate the relative distribution of patents granted to Bank of America during the first half of 2024 reflecting the bank's priorities in technological investment within a strategic framework that enhances operational efficiency, cyber security and digital innovation.

Information Security ranked first with 26%, indicating the allocation of significant resources to protect the digital infrastructure and reduce operational risks, This is a rational choice given the rise in cyber threats and their impact on the stability of financial systems.

Following it is Artificial Intelligence and Machine Learning at 17%, reflecting the bank's direction towards enhancing its analytical and predictive capabilities through intelligent automation to support decision-making and reduce operational costs.

Programming Technologies constituted 14%, indicating the bank's interest in improving software infrastructure and enhancing the flexibility of digital systems.

In fourth place, Blockchain technology came in at 10%, highlighting this investment within the bank's efforts to adopt reliable and transparent solutions for transaction recording, in line with the global trend towards a decentralized economy.

Digital and mobile banking services (Online/Mobile/Consumer Banking) also received 10%, indicating the evolution of digital service models and the growing demand for

alternative banking channels. As for Payment Technology, it accounted for 9%, indicating the bank's efforts to improve the efficiency of payment systems and expand their capabilities within the platform economy.

With 8%, Data Analytics emerge as a pivotal tool in improving investment decisions and risk assessment,while the 5% allocated to Augmented/Virtual Reality represents a forward-looking investment aimed at testing the capabilities of interactive user interface technologies in the banking sector. This distribution represents a balanced economic approach between investments aimed at enhancing efficiency and security on one hand, and those dedicated to exploring innovative solutions that respond to future transformations in the digital economy on the other.

The bank's focus on investing in cybersecurity, artificial intelligence, and data analytics reflects a strategic commitment to enhancing operational risk management and protecting its digital infrastructure, which supports the efficiency and security of banking operations.

Erica smart assistant in customer service : The Erica service, relies on artificial intelligence techniques based on natural language processing and machine learning to accurately understand and respond to customer inquiries without using generative linguistic models, but rather relies on analyzing the user's intentions and choosing the appropriate response. Through frequent interaction, Erica improves as specialized teams constantly review and update their responses. This service is part of the mobile banking application, providing customers with smart and personalized financial guidance, while fully adhering to security and privacy protection standards (Bank of America, n.d.)

Fig3. Erika Development Journey



Source. (Bank of America, 2024)

This reflects the digital transformation journey of Bank of America by tracking the evolution of the smart assistant "Erica" from its launch in 2018 to reaching 2 billion interactions in April 2024. The number of users increased from 2 million in 2018 to 40 million in 2023, with a gradual expansion of "Erica's" functions from providing information to investment and sales services through integrations with platforms like Merrill and CashPro. These updates have contributed to achieving more than 1.5 million interactions daily, indicating a significant shift towards automation in meeting banking demand, reducing operational costs, and improving service efficiency, This trajectory also reflects the bank's shift towards a digital business model based on data, automated interaction, and reshaping

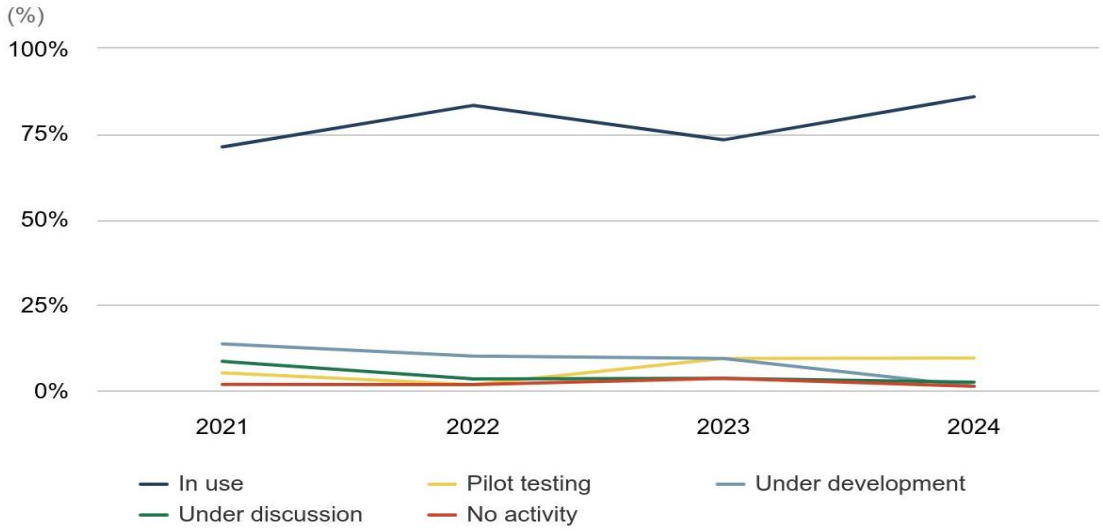
customer relationships to enhance their loyalty.

In the global banking sector, Bank of America achieved a digital milestone in 2024 by recording $1 trillion in approved payments via the CashPro application, and the Erica smart assistant contributed to processing more than 40% of customer inquiries within the CashPro Chat platform. At the individual level, the bank added 1.1 million new current accounts, continuing continuous growth over 24 consecutive quarters. Customer investment via Merrill Edge rose to $518 billion, a 22% year-over-year increase. The bank also maintained its position as the largest small business lender in the United States for the fifteenth consecutive quarter. (Bank of America, 2025).

*3.1.2.*The experience of the European Economic Area:

Banks are facing significant challenges in maintaining their competitiveness with each other due to their increasing reliance on the digitization of banking services and artificial intelligence to meet customer needs through the provision of personalized services. Like other global banks, European banks have adopted a digital transformation strategy, following strict regulations since Europe has always been one of the most regulated markets in terms of developing services and protecting data privacy, starting with the General Data Protection Regulation (GDPR), as is the case with the adoption of artificial intelligence technologies as well (McKinsey & Company, 2023).

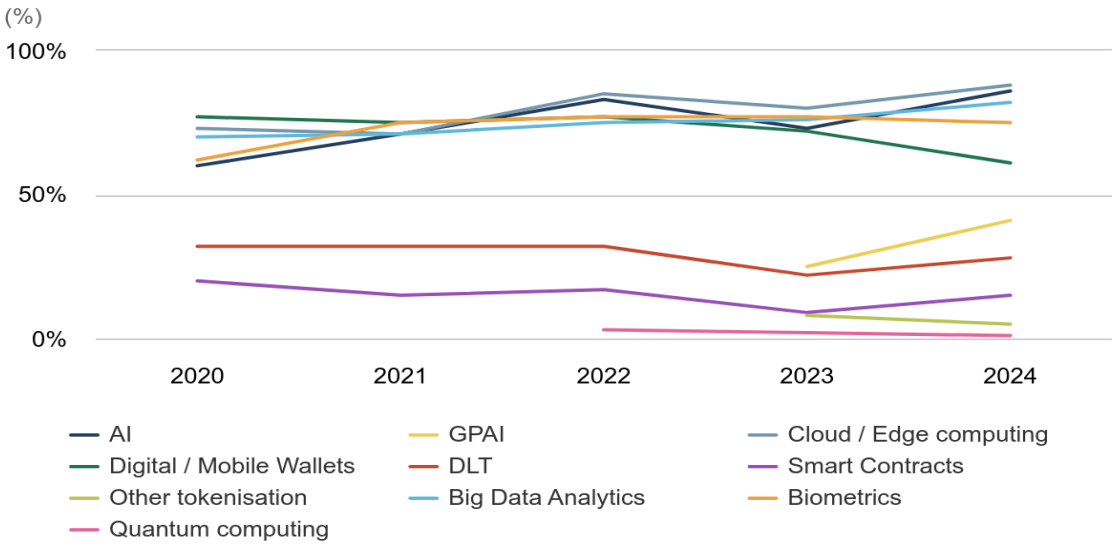
Fig4.Evolution of the adoption level of AI by EU banks



Source. (European Banking Authority - EBA, 2024).

The figure shows a gradual development in the adoption of artificial intelligence within European banks between 2021 and 2024, where the percentage of actual usage has increased, while there has been a decline in preliminary stages such as "under development" and "under discussion." This reflects the transition of banks from the exploration and experimentation phase to the full integration of artificial intelligence within their operational structure. It also shows the decline in experimental tests and that artificial intelligence has become an essential component in banking digitization strategies.

Fig5. Proportion of EU banks using different technologies

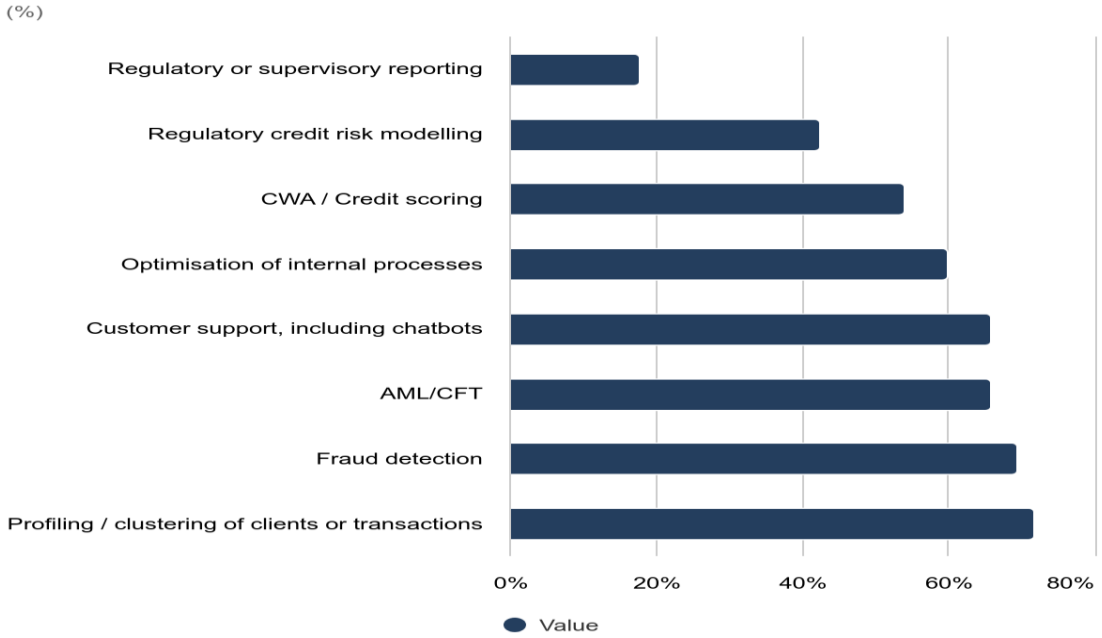


Source. (European Banking Authority - EBA, 2024)

The figure shows that the most widely used technologies (over 70%) : Artificial Intelligence AI , Cloud/Edge computing, Big Data Analytics, and Biometrics were among the most used technologies, all with usage rates ranging between 70% and 90% by the end of 2024. A gradual increase in the adoption of AI, Cloud, and Big Data has been observed reflecting a strategic shift towards using analytical tools and advanced processing to support decision-making, automation, and operational efficiency improvement. The adoption of Biometrics has seen relative stability since 2022, indicating the maturation of its use as a solution for security and identity verification.

- Technologies with a noticeable decline or contrast : Digital/Mobile Wallets have significantly declined after 2022 from about 75% to less than 60% in 2024, which may reflect either market saturation, a move towards alternative payment solutions or reduced focus from banks on this service in favor of third parties DLT Distributed Ledger Technology maintained stability, then declined in 2023 before rising again in 2024, suggesting practical implementation difficulties despite its great potential.
  Smart Contracts and Other Tokenisation have maintained low rates, indicating that Web3 or blockchain-based applications are still in experimental stages or limited banking use.
- Emerging technologies Emerging technologies : Generative AI witnessed a significant leap between 2023 and 2024 from about 25% to over 40% indicating the entry of this type of artificial intelligence into banking usage, perhaps in content creation or supporting customer interaction.
  Quantum computing remains at the lowest levels <5% throughout the period, reflecting that it is still far from practical adoption in the short term, despite academic interest in it.

Fig6.Uses of AI by EU banks per use case in 2024



Source. (European Banking Authority - EBA, 2024).

The data shows that European banks widely use artificial intelligence in areas such as profiling/clustering of clients or transactions, fraud detection, and AML/CFT, which are among the most common applications. Artificial intelligence is also used to a moderate extent in the optimization of internal processes and CWA / credit scoring. As for tasks of a regulatory nature, such as regulatory credit risk modeling and regulatory or supervisory reporting, the use of artificial intelligence remains limited due to the complexity of regulatory requirements and the sensitivity of these functions.

also highlight the growing role of artificial intelligence as a strategic tool in risk management, by enhancing banks' capabilities to detect fraud, supporting compliance with anti-money laundering and terrorist financing requirements, and improving credit risk assessment, which contributes to enhancing the flexibility and stability of banking institutions.

A. Intesa Sangallo's experience in using artificial intelligence:

The Artificial Intelligence Lab at the Intesa Sanpaolo Innovation Center was established in 2018 in collaboration with leading academic institutions to promote open innovation in applied research, the lab focuses on developing algorithms and mathematical models to enhance business efficiency and decision-making, contributing to intellectual property and scientific output. Artificial intelligence is the lab's core technology, used to build systems that simulate human cognition and address operational and strategic challenges. (Intesa Sanpaolo Innovation Center, 2023)

The practical application of these efforts was evident on October 9, 2023, when Intesa Sanpaolo became the first bank in Europe to use artificial intelligence to analyze regulations (Intesa Sanpaolo, 2023)

Intesa Sanpaolo Group, in cooperation with the Department of Corporate Affairs and External Communications (CIAECO), continues its path of digital transformation, after introducing the "Lisa" tool (Lisa - Linguistic Intelligence for Supervisory Awareness), a technology based on machine learning, which enables the reading and processing of thousands Documents related to banking supervision with high accuracy and speed. (Intesa Sanpaolo, 2023)

Intesa Sanpaolo has adopted artificial intelligence for regulatory analysis, becoming the first

European bank to apply this technology in the field in partnership with Aptus.AI a company specialized in regulatory technology, the project developed with support from Deloitte Risk Advisory aims to accelerate and improve the efficiency of setting the regulatory agend, it focuses on tracking new regulations, analyzing their impact, identifying risks and automatically generating customized documents while enabling employees to concentrate on specialized analysis, this initiative is part of the group's broader digital transformation which also includes the adoption of the AI-based tool LISA for analyzing banking supervision publications. (Intesa Sanpaolo Group, 2023)

Intesa Sanpaolo has developed the Lisa tool an intelligent system based on machine learning and natural language processing (NLP) designed to efficiently analyze thousands of documents related to banking supervision it extracts semantic patterns and objective correlations, and possesses predictive capabilities that help identify future trends at an early stage, Lisa is part of a collaboration with specialized academic centers, with the goal of enhancing banking services, however, the human expertise remains essential in interacting with the tool by validating results and improving its performance in recognition of its excellence in applying artificial intelligence this project received the John McCarthy Manager + AI Success Stories award during Rimini AI Week. (Intesa Sanpaolo Group, 2023)

3.1.3. Comparative Mapping of AI Adoption and Performance Impact in Global Banking

Table3 . AI Adoption and Performance Impact in Selected Banks

Bank / Case	AI Application	Application Area	Performance Impact
Bank of America	•Intelligent Receivables payment system.& *Erica* (NLP assistant)	• Automation of commercial accounts receivable and prediction of outstanding invoices. • Customer service for retail and corporate clients, providing personalized financial guidance through CashPro.	• 50% increase in automated invoice processing • 40 million Erica users and 2 billion interactions (2024) • Over 40% of corporate inquiries fully AI-managed
Euro Area Banks (EBA, 2024)	• Integration of AI with cloud computing, big data, Generative AI (GenAI), and biometric technologies.	• Customer segmentation and transaction profiling. • Fraud detection and compliance with Anti-Money Laundering and Counter-Terrorist Financing (AML/CFT) regulations.	• More than **75%** of banks transitioned from pilot projects to operational AI deployment in 2024. • Adoption of **Generative AI** increased from **25%** to over **40%**. • Improved digital identity protection and reduced fraud vulnerabilities.
Intesa Sanpaolo	• LISA (AI-powered regulatory intelligence)	• Regulatory analysis • Automated monitoring of legal and supervisory documents	• Faster regulatory updates and compliance documentation • Greater employee focus on strategic tasks

Source. Prepared by the author, based on data and reports from the selected banks.

The analytical review of the selected case studies reveals a strategic divergence in the drivers of technological investment. The American model primarily emphasizes the automation of core operational processes and the reduction of individual transaction costs to maximize profitability and market expansion. In contrast, the European model, exemplified by Intesa Sanpaolo, focuses on risk management, the automation of regulatory compliance, and the interpretation of complex legal and supervisory documents through the LISA platform. Despite these strategic differences, the case studies converge in demonstrating AI's

capacity to reduce administrative costs and improve operational efficiency, particularly through a lower cost-to-income ratio. The **50%** automation rate in invoice processing achieved in the United States, together with AI adoption exceeding **75%** among European banks, has generated tangible economic benefits that are consistent with (S&P Global, 2024) estimates indicating that lower operating costs can enhance return on equity (ROE) by approximately 100 basis points.

Nevertheless, the implementation challenges reveal important protective and governance-related dimensions. Large-scale automation in the American model has been accompanied by increasing cybersecurity risks and difficulties in processing unstructured data, whereas the European model has faced stringent privacy regulations under the General Data Protection Regulation **(**GDPR), along with the semantic complexity of legal and regulatory texts. These findings highlight the importance of addressing structural deficiencies in banks' digital infrastructure before deploying AI solutions to avoid fragmented legacy systems, commonly referred to as Spaghetti Architecture, through the establishment of unified data repositories. This should be complemented by expanded investment in RegTech solutions capable of continuously monitoring regulatory requirements issued by central banks, thereby reducing compliance risks and minimizing exposure to regulatory penalties.

4. Conclusion

Building upon the foregoing analysis and comparative assessment, this study concludes that the integration of artificial intelligence (AI) technologies into the banking sector is no longer a strategic option but an essential imperative for enhancing banking performance and maintaining competitiveness in an increasingly digital financial environment. However, the long-term economic benefits of this transformation cannot be achieved automatically. Rather, they depend fundamentally on the readiness of digital infrastructure, the development of human capital, and the modernization of regulatory and legislative frameworks.

In this context, the study argues that achieving sustainable financial performance requires the adoption of a hybrid management model that combines human managerial expertise with AI capabilities (Manager + AI), rather than pursuing full digital substitution. Such an approach ensures continuous human oversight to mitigate the risks of semantic misinterpretation of regulations and to validate complex AI-generated outputs, particularly in highly regulated banking environments. Furthermore, this balanced model promotes the alignment of technological innovation with the objectives of sustainable financial inclusion by preventing the exclusion of individuals with limited digital readiness or insufficient technological skills. Consequently, technological advancement becomes an instrument of inclusive economic empowerment while remaining subject to continuous human supervision and evaluation.

The findings from the selected banking case studies further demonstrate that the true success of banking institutions should not be measured solely by the scale of their technological investments, but rather by their strategic ability to achieve a secure and intelligent integration of computational efficiency with human judgment. Such integration is essential for delivering banking services that are sustainable, secure, efficient, and equitable for all segments of society.

5. Findings

Through this research, we reached the following findings:

- The comparative analysis demonstrated that the adoption of artificial intelligence generates tangible operational benefits. Intelligent automation increased invoice-processing efficiency by **50%** at Bank of America, while the European banking sector experienced a significant transition from pilot initiatives to full-scale AI integration, with adoption rates exceeding **75%** in 2024.
- The study revealed that the failure to fully realize the benefits of digital transformation is closely associated with reliance on legacy technological infrastructures characterized by **"Spaghetti Architecture"**, as well as the simultaneous management of legacy and modern

systems. This dual-system environment increases operational complexity and leads to higher implementation and maintenance costs.

- The analysis also identified clear differences in AI adoption priorities across banking models. While the U.S. banking model primarily emphasizes customer engagement, service innovation, and business expansion, the European model places greater emphasis on leveraging AI for regulatory compliance, fraud detection, and anti-money laundering and counter-terrorist financing (AML/CFT) in alignment with European regulatory requirements.
- Artificial intelligence has become a strategic necessity in banking operations, and its adoption is no longer an option but a prerequisite for enhancing competitiveness and responding effectively to market demands and ongoing digital transformation.
- The impact of artificial intelligence on operational efficiency is evident, as the experiences of global banks such as Bank of America have demonstrated tangible improvements in risk management and operational cost reduction.
- Digital transformation cannot be successfully achieved without robust digital infrastructure and qualified human resources. Continued reliance on legacy technological systems, coupled with shortages in data analytics and AI expertise, remains a major barrier to the effective adoption of artificial intelligence.

6. Recommendations

- Banks should prioritize modernizing their data infrastructure by replacing fragmented legacy systems with integrated data platforms, cloud-based solutions, and advanced analytics capabilities to maximize the efficiency and effectiveness of artificial intelligence applications
- The successful deployment of artificial intelligence requires adaptive regulatory and governance frameworks that foster innovation while safeguarding customer data privacy. In this regard, RegTech solutions should be leveraged to strengthen regulatory compliance and enable continuous monitoring of evolving supervisory requirements.Investing in human competencies by training and qualifying specialized employees in artificial intelligence.
- Developing a flexible and clear regulatory framework should consider the balance between innovation, legal protection, and privacy in new technological legislations (such as the European AI Act).
- Taking advantage of the experiences of leading banks such as Bank of America's "Erica" smart assistant, or Intesa Sanpaolo's experience in legislative analysis as lessons that can be adapted locally
- To ensure sustainable digital transformation, banking institutions should promote a human–AI collaborative operating model by investing in workforce reskilling and upskilling. This approach preserves human judgment and ethical oversight while enhancing the quality of credit and operational decision-making.

7. References

Ford, L., & Elisa , I. (2019). Digital Banking Transformation: Application of Artificial Intelligence and Big Data Analytics for Leveraging Customer Experience in the Indonesia Banking Sector. *8th International Congress on Advanced Applied Informatics (IIAI-AAI), IEEE* (p. 6). Toyama Japan: Toyama International Conference Center.

Bank for International Settlements BIS. (2024). *Digitalisation of Finance.* Switzerland: Basel, Switzerland: Bank for International Settlements.

Bank of America. (2024, April 15). *BofA's Erica surpasses 2 billion interactions, helping 42 million clients stay on top of their finances*. Consulté le May 30, 2025, sur Bank of America Newsroom: https://newsroom.bankofamerica.com/content/newsroom/press-

releases/2024/04/bofa-s-erica-surpasses-2-billion-interactions--helping-42-millio.html

Bank of America. (2025). *Bank of America Annual Report 2024*. Charlotte, North Carolina, USA: Bank of America Corporation.

Bank of America BofA. (2024, 10 23). *AI Patents at BofA Increase 94% Since 2022*. Consulté le 06 2025, 17, sur https://newsroom.bankofamerica.com/content/newsroom/press-releases/2024/10/ai-patents-at-bofa-increase-94--since-2022.html

Bank of America. (n.d.). *Meet Erica: Your virtual financial assistant*. Consulté le May 30, 2025, sur https://info.bankofamerica.com/en/digital-banking/erica

Bhagyashree , N. D. (2018). Digitalization in Banking Sector. *International Journal of Trend in Scientific Research and Development (IJTSRD)*, 80-85.

BofA Bank of America. (2022, 10 24). *Bank of America Intelligent Receivables™ Upgraded With AR Forecasting Capabilities And Enhanced Reporting*. Retrieved 06 17, 2024, from https://newsroom.bankofamerica.com/content/newsroom/press-releases/2022/10/bank-of-america-intelligent-receivables-upgraded-with-ar-forecas.html

Chenini , H., & Jarboui , A. (2018). Analysis of the Impact of Governance on Bank. *Knowl Econ*, 872.

European Banking Authority - EBA. (2024, avril). *Special topic on Artificial Intelligence*. Retrieved 06 16, 2025, from https://www.eba.europa.eu/publications-and-media/publications/special-topic-artificial-intelligence

European Union. (2024). *EU AI Act.* Retrieved from EU AI Act recital12: https://artificialintelligenceact.eu/recital/12/#weglot_switcher

Feras , M. A., Samar , R., Mahmoud , A., & Abdul , H. N. (2023). Does artificial intelligence (AI) boost digital banking user satisfaction? Integration of expectation confirmation model and antecedents of artificial intelligence enabled digital banking. *Heliyon, 9*, 13.

Financial Institute. (2016). *Introduction to Insurance Basics.* Riyadh, Kingdom of Saudi: King Fahd National Publishing Library.

Francesca , B., Paola , F., & Antonella , A. (2021). The digitalization-reputation link: a multiple case-study on Italian banking groups. *Meditari Accountancy Research*, 31.

Ghandour, A. (2021). Opportunities and Challenges of Artificial Intelligence in Banking: Systematic Literature Review. *TEM Journal, 10*(4), 1581–1587.

Happiest Minds Technologies. (2023). *Digital Transformation in Banking – The Future of Banking.* Happiest Minds Technologies.

He , J., Huang , S., Cheng , Z., Liang , Y., & Liu , Y. (2024). AI-Driven Digital Transformation in Banking: A New Perspective on Operational Efficiency and Risk Management. *Information Systems and Economics*, *5*(1), 9.

IDRBT Institute for Development and Research in Banking Technology. (2020). AI in Banking: A Primer: IDRBT.

Intesa Sanpaolo. (2023, October 9). *Intesa Sanpaolo First European Bank to Use Artificial Intelligence for Regulatory Analysis*. Retrieved 06 21, 2025, from Intesa Sanpaolo – Newsroom: https://group.intesasanpaolo.com/en/newsroom/press-releases/2023/10/intesa-sanpaolo-first-european-bank-to-use-artificial-intelligen

Intesa Sanpaolo Group. (2023, 12 6). *AI Supports Regulatory Analysis*. Retrieved 19 06, 2025, from https://group.intesasanpaolo.com/en/newsroom/all-news/news/2023/ai-supports-regulatory-analysis

Intesa Sanpaolo Group. (2023, 06 26). *Machine learning and banking supervision*. Consulté le 06 2025, 19, sur Intesa Sanpaolo – Newsroom: https://group.intesasanpaolo.com/en/newsroom/all-news/news/2023/machine-learning-and-banking-supervision

Intesa Sanpaolo Innovation Center. (2023). *Artificial Intelligence Lab*. Consulté le 06 21, 2025, sur https://www.intesasanpaoloinnovationcenter.com/en/applied-research/artificial-intelligence-lab/

McKinsey & Company. (2023, November 15). *How generative AI can improve customer experiences in Europe.* Retrieved 02 13, 2025, from McKinsey & Company: https://www.mckinsey.com/featured-insights/lifting-europes-ambition/videos-and-podcasts/how-generative-ai-can-improve-customer-experiences-in-europe#/

McKinsey. (2024, Mars). *McKinsey Digital*. Retrieved mai 18, 2025, from McKinsey: https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/tech-forward/next-gen-banking-success-starts-with-the-right-data-architecture

Mohit , K., Mohit , R., Anshu , C., Kamal, K. P., Anshul , S., & Sudha , P. (2024, 12 2). The Impact of Artificial Intelligence on the Banking Sector. *African Journal of Biomedical Research, 27*, 95-100.

Mohit , K., Mohit , R., Anshu , C., Kamal, K. P., Anshul , S., & Sudha , P. (2024, 12 2). The Impact of Artificial Intelligence on the Banking Sector. *African Journal of Biomedical Research, 27*, 95-100.

OECD. (n.d.). *OECD AI Principles overview.* Retrieved from https://oecd.ai/en/ai-principles

Pamarthi, K. (2024). Analysis on Opportunities and Challenges of AI in the Banking Industry. *International Journal of Artificial Intelligence and Data Science (IJADS)*, 10–23.

Phuong , T., Thi , T., & Nga , H. (2023, May 08). Digital transformation of the banking industry in developing countries. *International Journal of Professional Business Review*, 25.

Pragma. (2024). *Artificial Intelligence for Banking: Unlocking the Future of Financial Services.* Pragma.

Riris , S., Wahyu , A., & Wahyu , A. (2022). A systematic review on banking digital transformation. *Jurnal Administrare:Jurnal Pemikiran Ilmiah dan Pendidikan Administrasi Perkantoran, 9*(2), 543-552.

S&P Global. (2024, 04 26). *AI in Banking: AI Will Be an Incremental Game Changer*. Retrieved 06 14, 2025, from S&P Global: https://www.spglobal.com/en/research-insights/special-reports/ai-in-banking-ai-will-be-an-incremental-game-changer?utm_source=chatgpt.com

Sofiane , L., Benziane , R., Abdelhak , L., Salwa, E. A., Ramzi , B., & Youcef , S. (2023). An Arab Country's Digital Shift: A Case Study on Factors Influencing Mobile Banking Adoption in the Arab World. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration, 31*(1), 15.

Tajudeen , A., & Rofiat , B. (2024). Artificial Intelligence (AI) in the Banking Industry: A Review of Service Areas and Customer Service Journeys in Developing Economies. *Business & Management Compass, 68*(3), 19 - 43.