

AI Applications in Sustainable Banking: A Review of Applications, Challenges and Opportunities

Md Habibur Rahman^{1*}, Hasinat Raquiba¹, Md Abdul Mannan Khan¹, Mijanur Rahman², Sangida Akter Saroni¹

¹Department of Accounting and Information Systems, Gopalganj Science and Technology University, Gopalganj, Bangladesh

²Department of Business Administration, International Islamic University Chittagong (IIUC), Chittagong, Bangladesh

***Corresponding Author:** Md Habibur Rahman

Department of Accounting and Information Systems, Gopalganj Science and Technology University, Gopalganj, Bangladesh

Article History

Received: 05.08.2025

Accepted: 03.10.2025

Published: 04.11.2025

Abstract: The convergence of Artificial Intelligence (AI) and sustainable banking is transforming the global financial landscape, presenting both extraordinary opportunities and significant challenges. This paper provides an in-depth review of AI applications in the banking sector, elaborating on their role in advancing efficiency, enhancing customer experience and promoting financial inclusion, while also examining their implications for sustainability. Drawing on a thematic analysis of scholarly literature, case studies, industry reports and studies, this analysis identifies key applications of AI in fraud identification, credit risk management, wealth management, customer service automation and regulatory compliance. Further than operational welfare, the review centre is evolving sustainability-focused on uses of AI, comprising environmental, social and governance (ESG) risk calculation and green finance simplification. However, major challenges remain, notably data privacy risks, algorithmic bias, regulatory uncertainty, high operational costs, workforce disruptions and the environmental impact of AI systems. The analysis underscores significant gaps in aligning AI adoption with broader sustainability goals, regulatory expectations and ethical standards. To address the identified loopholes, this research recommends future research strategies focused on the development of accountable AI frameworks, explainable AI, stronger regulatory harmonization and inclusive financial contact. The findings contribute to both theory and practice by combining fragmented insights, providing a structured framework for indulgent AI's dual role in efficiency and sustainability and offering legal guidance for policymakers, regulators and banking authorities. Ultimately, this study highlights AI not only as a driver of operational conversion but also as a catalyst for building a more comprehensive, robust and practical global banking environment.

Keywords: Artificial Intelligence, Sustainable Banking, ESG, Technological Innovation, Explainable Artificial Intelligence.

1. INTRODUCTION

The global banking sector has been undergoing a vital transformation determined by the dual forces of high-tech innovation and long-term necessities (AL-Dosari *et al.*, 2024; Rodrigues *et al.*, 2022). The financial sector, mainly the banking industry, has historically helped as the backbone of worldwide economies, surfacing endlessly in reaction to technological advancement, regulatory fluctuations and changing customer demands (Roy *et al.*, 2025). From branch-based services to the advent of ATM, online banking and mobile banking through mobile applications, financial organizations have gradually embraced digital transformation to improve efficiency and increase customer experiences (Alnaser *et al.*, 2023). In recent years, Artificial Intelligence has emerged as the latest frontier in this change, offering unprecedented opportunities for innovation across various banking functions (Alsoukuni *et al.*, 2025; Paramesha *et al.*, 2024). By leveraging ML, NLP, RPA and predictive analytics. At present, banks can process massive datasets, automating routine

Copyright © 2025 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

CITATION: Md Habibur Rahman, Hasinat Raquiba, Md Abdul Mannan Khan, Mijanur Rahman, Sangida Akter Saroni (2025). AI Applications in Sustainable Banking: A Review of Applications, Challenges and Opportunities. *South Asian Res J Bus Manag*, 7(6), 462-474. 462

work, providing better scope for existing employees to focus on more complex tasks and delivering highly personalized suggestions for financial matters at scale (El Hajj & Hammoud, 2023; Rodrigues *et al.*, 2022; Zheng *et al.*, 2025).

Though at the present time the integration of AI into the banking industry successfully aligns with customer needs, it remains a complex and evolving phenomenon. The current study has known its applications in fraud identification, credit scoring, robo-advisory services, regulatory obedience, loan risk management and customer service automation (Aziz & Andriansyah, 2023; Mohammed *et al.*, 2024; Zhang *et al.*, 2022). These studies ensure AI's capability to improve operational efficiency, lessen risks and improve financial inclusion (El Hajj & Hammoud, 2023; Roy *et al.*, 2025). However, challenges such as a lack of digital literacy, data privacy threats, algorithmic bias, regulatory ambiguity and huge implementation expenses raise significant questions about the ethical, social and environmental implications of AI in financial services (Afroogh *et al.*, 2024; Moharrak & Mogaji, 2025; Yenduri *et al.*, 2024). In addition, while Artificial Intelligence's role in developing efficiency is well-recognised, its contributions to sustainable banking, particularly in zones such as environmental, social and governance risk calculation, sustainable or green finance and responsible lending, remain underexplored.

A critical evaluation of the literature discloses several gaps. Firstly, much of the existing research is fragmented between technically driven analyses of AI applications and theoretical discussions of consumer trust, ethics and regulation (Wijethilake, 2025). This disengagement limits the growth of comprehensive frameworks that address together technological capabilities and socio-economic consequences. Again, earlier studies have mainly focused on operational benefits, reducing inequality and raising financial sustainability with scarce attention to Artificial Intelligence's role in constructing long-term trust (Alsoukini *et al.*, 2025; Pan & Nishant, 2023). Lastly, the environmental impact of Artificial Intelligence tools themselves has not received enough attention (Mei *et al.*, 2024), which raises concerns about the paradox of leveraging resource-intensive technologies to promote sustainability in the financial sector.

Based on the above-identified loopholes in the existing literature, this article aims to address the following pivotal research questions: (a) How is Artificial Intelligence reshaping banking operations, customer service and risk management? (b) What regulatory, ethical and environmental challenges constrain its viable adoption? (c) In what ways can Artificial Intelligence be aligned with Environmental, Social and Governance objectives and how does inclusive banking apply? As well as (d) How many banks incorporate Human-Artificial Intelligence collaboration models to ensure that employees are empowered rather than displaced?

The objectives of this study are fourfold: (i) To trace the historical development of AI in banking, highlighting key technological milestones; (ii) To examine the current applications of AI in enhancing efficiency, customer engagement and sustainability; (iii) To analyse the challenges, including ethical dilemmas, regulatory uncertainty and resource constraints; (iv) To forecast future directions by proposing strategies for responsible and sustainable AI integration in global banking.

By addressing the identified objectives, this study makes significant scholarly contributions. First, it consolidates and synthesizes a fragmented body of literature on Artificial Intelligence in banking, providing a structured thematic framework that integrates technical, operational, ethical and sustainability perspectives. By tracing the historical evolution of AI, examining current applications and highlighting key technological milestones, the study offers a comprehensive understanding of how AI has reshaped banking operations, customer service, and risk management. Furthermore, it systematically identifies the challenges-ethical dilemmas, regulatory uncertainty and resource constraints-that have constrained AI adoption, thereby clarifying critical areas for future research and policy attention. In this study, we analyze the disclosure on Artificial Intelligence beyond its conventional association with operational efficacy to illuminate its rigorous potential for instituting long-term and inclusive banking paradigms. Lastly, this article provides a critical bridge between specific AI deployments and the fulfillment of environmental, social and governmental criteria through effective human and artificial symbiosis and yielding practical guidance for governance bodies as well as financial practitioners. As a result, the study re-envision artificial intelligence not as a simple tool but as a fundamental strategic enabler, proficient in cultivating financial architectures characterized by resilience, inclusivity and sustainability. This perspective is intended to guide current operational frameworks and stimulate future scholarly exploration.

2. LITERATURE REVIEW

2.1. Artificial Intelligence

The domain of Artificial Intelligence concerns the computational simulation of human cognitive faculties, including learning, problem-solving and judgment (Haleem *et al.*, 2022; Rani *et al.*, 2025; Valavanidis, 2023). Within the financial services industry, the adoption of AI technologies spanning machine learning, natural language processing, robotic process automation and predictive analytics is accelerating (Aziz & Andriansyah, 2023; Mei *et al.*, 2024; Narayanan, 2025). In addition, this mechanism mentioned strengthens financial institutions to analyse immense volumes of heterogeneous data, extracting previously indiscernible patterns to inform critical decision-making processes (Fares *et*

et al., 2022; Rahman *et al.*, 2023). For instance, ML techniques are refining credit risk assessment by evaluating multifaceted customer data (Faheem, 2021), while NLP applications are revolutionizing client interactions through intelligent, automated support systems interactions (Patil, 2024; Vashishth *et al.*, 2024). RPA streamlines repetitive operational processes, reducing errors and improving efficiency (Lubis & Sembiring, 2023). Predictive analytics enables proactive risk management, fraud detection and portfolio optimization (Javaid, 2024). Beyond efficiency, AI also supports sustainability and ESG objectives by facilitating green lending decisions, monitoring environmental and social risks and ensuring regulatory compliance (Elhady & Shohieb, 2025; Rane *et al.*, 2024b). Furthermore, AI-driven analytics can promote financial inclusion by designing products tailored to underserved populations, thereby reinforcing the strategic role of AI as a transformative enabler of innovation, resilience and accountable banking practices (Vasile & Manta, 2025; Yıldız & Demir, 2024).

2.2. Sustainable Banking

Traditionally, banking services were highly branch-centric, relying heavily on face-to-face interactions between customers and employees (Sheth *et al.*, 2022; Wang *et al.*, 2025). With the advancement of information and communication technologies, banks gradually shifted toward telephone banking, ATMs and online banking platforms, which enabled customers to access financial services with greater convenience and reduced reliance on physical branches (Rahman *et al.*, 2015; Rahman *et al.*, 2024; Zheng, Rahman, *et al.*, 2023). In the previous twenty years, the rise of mobile banking and financial technology or fintech innovations, has further reshaped customer service, emphasizing speed, accessibility and personalization (Kayed *et al.*, 2025; Rahman *et al.*, 2024; Wu *et al.*, 2024). This evolution underscores a clear trajectory from manual, human-driven services to digitally enabled, customer-centric models, setting the stage for AI adoption (Dewasiri *et al.*, 2023; Roy *et al.*, 2025).

The continuous change in the digital banking system is increasingly orchestrated by Artificial Intelligence, which strengthens institutions to automate standard processes, enhance predictive capabilities for risk assessment, tailor customer engagements through intelligent analytics and optimize operational performance efficiency (Rodrigues *et al.*, 2022; Tian, 2024). Surpassing detection of only efficiency, AI also serves as a cornerstone for responsible banking, enabling lending practices that adhere to ESG principles, ethical fraud detection mechanisms and inclusive financial strategies derived from sophisticated data analysis (Elhady & Shohieb, 2025; Mercier-Laurent, 2021; Thomas *et al.*, 2025). The convergence of technologies, therefore, embodies a strategic paradigm shift one that is essential for forging a financial ecosystem characterized by higher resilience, inclusivity and environmental stewardship (Dewasiri *et al.*, 2023; Fernandes *et al.*, 2024; Ul Huq *et al.*, 2016).

2.3. Applications of AI in the Banking Sector

The modern banking industry has been significantly affected after the introduction of Artificial Intelligence tools, affecting a fundamental change in how financial institutions manage risk, interact with clients and ensure regulatory adherence (Alsoukini *et al.*, 2025; Moharrak & Mogaji, 2025). Among its most transformative applications is the domain of fraud detection and risk management. Incorporating machine learning tactics, banks can scrutinize massive transactional datasets in real-time to detect anomalies, a capability that is instrumental in reducing financial exposure and fortifying security protocols (Aziz & Andriansyah, 2023; Javaid, 2024). Again, in credit scoring and loan approval, AI models go beyond traditional financial indicators by integrating alternative and non-traditional data sources, such as social behaviour, transaction patterns and digital footsteps, to generate more exact and inclusive valuations of solvency (Alnaser *et al.*, 2023; Pan & Nishant, 2023).

Customer engagement has also been hugely changed through virtual assistants like chatbots, which are powered by natural language processing (NLP), providing 24/7 support, answering queries and streamlining routine tasks, meaningfully reducing response times and enhancing the overall customer experience (Abiagom & Ijomah, 2024; Mondal *et al.*, 2015; Nithya, 2024). In wealth management, AI-driven robo-advisors offer personalized investment advice, computerized portfolio management and predictive insights founded on market trends, enabling banks to deliver sophisticated financial design services at scale (Challa, 2023; Ibrahim *et al.*, 2025; Zha & Mitra, 2024).

In addition to aligning all legal matters with proper rules and regulations, the banking industry has benefited heavily from AI's capability to monitor great volumes of transactions for suspicious patterns, ensuring obedience to AML and KYC regulations and helping banks reduce the risk of penalties or damage to goodwill (Paleti, 2022; Shirvanporzour, 2025; Turksen *et al.*, 2024). Besides these positive matters, the Artificial Intelligence and Explainable Artificial Intelligence support tactical goals, including the integration of ESG criteria, optimization of operational efficiency and promotion of financial inclusion (Limajatini *et al.*, 2025; Rane *et al.*, 2024b). By its present functions, Artificial Intelligence is not only acting as a technological tool but also revolutionizing resilience, customer satisfaction and sustainable banking practices in the overall financial environment (Alonge *et al.*, 2021; Manta *et al.*, 2025; Rahmani & Zohuri, 2023).

2.4. Enhancing Customer Experience through AI

Artificial Intelligence is basically shaping customer experience within the banking sector by driving significant advancements in personalized service, operational efficiency and service accessibility (Kovvuri, 2024; Sheth *et al.*, 2022). Automation of frequently occurring questions, including account-related questions and transaction histories, expedites service resolution, thereby elevating customer satisfaction (Favour *et al.*, 2025; Rane *et al.*, 2024a; Vashishth *et al.*, 2024). In addition, AI facilitates sophisticated personalization on digital platforms, curating recommendations for financial products like loans and investment opportunities based on individual customer profiles and behaviours (Kumar, 2020; Sultana & Faisal, 2024). The exact proposed approach not only deepens client engagement but also creates greater scope for effective cross-selling activities.

Through some significant way like predictive analytics, AI equips institutions to forecast customer behaviour, pre-empt potential risks and address service weaknesses before they intensify. These capabilities are crucial for constructing seamless omnichannel experiences, guaranteeing consistency whether a customer interacts via digital, mobile, or in-branch channels (Aziz & Andriansyah, 2023; Dzureke, 2025). Additionally, a major secondary feature is reallocation of human capital; by automating mundane tasks, AI liberates staff to focus on complex, high-value functions such as personalized financial advising and strategic relationship management (Met *et al.*, 2019; Sharma *et al.*, 2025). The significant co-operation between automated efficiency and accuracy with human mastery fosters high trust and loyalty, recasting AI from just a cost-saving instrument into a strategic asset for cultivating superior customer experiences (Igwe-Nmaju *et al.*, 2023). Ultimately, this evolution supports a broader shift from transactional interactions to a relationship-centric banking model, aligning service delivery with the long-term expectations and needs of the customer (Chakraborty *et al.*, 2025; Masum Miah *et al.*, 2012; Yang *et al.*, 2024).

2.5. Impact of AI on Banking Employees

After the introduction of Artificial Intelligence in the banking sector, it has redesigned the workforce in banking services, presenting both opportunities and challenges. On the positive side, automation of routine and repetitive tasks enables employees to redirect their efforts toward more strategic, customer-centric and creative roles, such as financial advising, product development and relationship management (Alakotila, 2023; Ochieng, 2024; Zheng, Chowdhury, *et al.*, 2023). This changeover can enhance job satisfaction, as employees can contribute to higher-value activities that demand human judgment and empathy qualities that machines cannot easily replicate (Perera, 2025). However, alongside these benefits, there are growing concerns about job displacement, particularly in back-office functions, transaction processing and routine package roles that AI systems can perform more efficiently (Megargel *et al.*, 2025; Spring *et al.*, 2022).

At the present time, AI adoption is accelerating the demand for new skill sets, including data analytics, AI system management, programming literacy and digital communication skills (Challoumis, 2024; Rodrigues *et al.*, 2022). To adapt to this changing environment, banks must invest heavily in employee reskilling and continuous exercise programs, ensuring their workforce can work successfully alongside intelligent systems. Notably, the net impact of AI on employees is not predetermined; it depends largely on how institutions manage the transition and design human-machine collaboration models. Banks that integrate AI as a complement to human proficiencies, rather than a substitute, are more likely to foster empowered, future-ready employees and maintain stronger organizational resilience (Arshad *et al.*, 2025; Saba *et al.*, 2025).

2.6 AI in Risk Management and Fraud Detection

The deployment of Artificial Intelligence (AI) has fundamentally reshaped risk management and fraud detection in the banking sector, shifting practices from reactive investigations to proactive, real-time prevention (Appachikumar, 2025; Aziz & Andriansyah, 2023; Khan & Islam). AI-powered systems, using sophisticated machine learning (ML) and deep learning algorithms, continuously monitor vast volumes of transactional and behavioural data, establishing highly nuanced baselines for individual customers (Paramesha *et al.*, 2024). These systems excel at identifying subtle anomalies such as unusual transaction amounts, atypical geolocations, device changes, or abnormal spending velocities that would be imperceptible to human analysts or traditional rule-based systems (Khan *et al.*, 2025). By flagging doubtful activities within milliseconds, financial institutions can promptly block or suspend potentially fake or fraudulent transactions, thereby diminishing financial losses and enhancing customer trust.

One of the major pros of AI lies in its adaptive wisdom capabilities (Strielkowski *et al.*, 2025). Besides the previous rule-based systems, AI models developed with new datasets are constantly improving their ability to identify emerging fraudulent schemes, cyber threats and insider risks (Narender & Anand, 2025). This active learning ensures that fraud prevention tactics remain resilient against increasingly sophisticated attack patterns. In addition to fraud detection, AI-driven tools strengthen banks' regulatory compliance frameworks, particularly in areas such as Anti-Money Laundering and Know Your Customer requirements. Automated systems can cross-check large-scale customer records, flag inconsistencies and generate transparent, auditable compliance reports with remarkable efficiency (Van Vliet, 2023). Beyond immediate cost savings, these innovations have broader strategic benefits. AI-driven risk management reduces

operational inefficiencies, bolsters institutional credibility and supports long-term financial stability (Adekunle *et al.*, 2023; Zheng, Khan, *et al.*, 2023). Significantly, by implanting transparency and liability into risk systems, banks not only meet regulatory expectations but also align with ESG governance objectives, positioning themselves as trustworthy actors in an increasingly digitized financial ecosystem (Abramova, 2024).

2.7 AI and Credit Risk Assessment

Artificial Intelligence is altering credit risk assessment procedures by enabling a more holistic, accurate and inclusive evaluation of borrower creditworthiness (Faheem, 2021). Traditional credit scoring models, which rely primarily on historical credit bureau data and standardized financial ratios, often provide limited insights. They frequently exclude individuals with thin or non-existent credit files, such as young adults, gig-economy workers and recent migrants, thereby reinforcing financial exclusion (Elhady & Shohieb, 2025; Faheem, 2021).

AI-powered models overcome these limitations by integrating alternative data sources, including utility and rental payment histories, digital footprints, mobile phone usage patterns, social network interactions and transaction-level behavioural data from bank accounts (Pan & Nishant, 2023; Tian, 2024). Through upgrade techniques such as natural language processing (NLP), sentiment analysis and network analysis, AI systems uncover subtle indicators of financial accountability and stability that historical models fail to capture. This capability to process various and complex datasets enables the creation of more nuanced borrower profiles, reflecting not only repayment history but also real-time financial behaviours and adaptive capacity. The result is a significant improvement in the accuracy of credit risk predictions, reducing default rates while extending fair credit access to previously "unscorable" individuals (Piacentino, 2025). Banks and lending institutions benefit by being able to tailor interest rates and lending terms more precisely, aligning risk with pricing. At the same time, borrowers who were once excluded gain access to affordable credit, thereby advancing the goals of financial inclusion and social equity. Importantly, this approach also aligns with the social dimension of ESG, as AI-driven credit risk assessment facilitates responsible lending practices that broaden participation in the financial system while maintaining stability and accountability (Faheem, 2021; Oko-Odion, 2025).

2.8 AI in Investment and Wealth Management

The wealth management industry is undergoing a profound democratization driven by the integration of Artificial Intelligence (AI), particularly through the rise of robo-advisors and AI-powered portfolio management platforms (Ghosn, 2025). These digital systems deliver automated, algorithm-driven financial planning and investment services with minimal human intervention, fundamentally reshaping how client's access and engage with wealth management. By gathering data on financial goals, risk tolerance, income levels and time horizons through intuitive digital interfaces, robo-advisors apply modern portfolio theory in combination with machine learning techniques to construct, monitor and automatically rebalance diversified portfolios, often composed of low-cost exchange-traded funds (ETFs) (Salinas, 2024).

This high degree of automation translates into lower fees, reduced entry barriers and minimal account requirements compared to traditional wealth managers, thereby extending professional-grade investment services to a much broader audience (Onabowale, 2024). What was once the exclusive domain of high-net-worth individuals is now accessible to retail investors, students and middle-income households, signalling a structural shift in financial inclusion. Latest AI platforms go outside basic asset allocation by offering personalized insights, real-time risk assessments, tax-loss harvesting and continuous market sentiment analysis, thus providing tailored investment strategies that adapt vigorously to market fluctuations and client needs (Ibrahim *et al.*, 2025). Implications extend beyond cost savings. By combining scalability with personalization services, AI is reshaping client expectations, placing pressure on traditional financial advisors to integrate digital tools or risk obsolescence (Onabowale, 2024; Salinas, 2024). At the same time, the growing role of AI in wealth management raises questions about algorithmic transparency, investor trust and regulatory oversight, particularly in volatile markets (Olanrewaju, 2025). However, when designed responsibly, AI-powered investment solutions embody both efficiency and inclusivity, positioning them as a cornerstone of sustainable finance and a powerful contributor to the broader goals of financial democratization and ESG-aligned investing (Sundharesalingam *et al.*, 2023).

2.9 Ethical and Regulatory Considerations in AI Adoption

While Artificial Intelligence offers major benefits for efficiency, personalization services and risk management, its adoption in banking raises key ethical and regulatory challenges that must be carefully addressed to ensure sustainable and responsible integration (Paleti, 2022; Wijethilake, 2025). A central ethical concern is data privacy and security (Wang *et al.*, 2024). Banks manage highly sensitive customer information and the use of AI requires collecting and processing vast amounts of personal and financial data. Breaches or misuse of this data can severely undermine customer trust and expose institutions to reputational and legal risks (Afroogh *et al.*, 2024; Wijethilake, 2025).

Another critical issue is algorithmic bias and fairness. AI models are only as reliable as the data they are trained on; if datasets reflect historical biases or lack diversity, outcomes may inadvertently discriminate against certain groups, leading to unequal access to credit or financial services (Chaudhary, 2024). Such outcomes conflict with principles of

fairness, inclusion and the “social” dimension of ESG (Rane *et al.*, 2024b). Closely related to this is the challenge of transparency and explainability (Thiruma Valavan, 2023). Many AI systems, particularly those based on deep learning, operate as “black boxes,” making it difficult for regulators, auditors, or even banks themselves to fully explain how specific decisions such as credit approvals or fraud alerts are reached. This lack of interpretability raises accountability concerns, especially when customer livelihoods are affected. From a regulatory standpoint, uncertainty in legal matters remains a significant barrier. While worldwide regulators recognize the potential of AI, clear and consistent frameworks governing its use in financial services are still evolving. Banks often face fragmented guidelines across jurisdictions, complicating compliance and slowing adoption. Key regulatory priorities include ensuring adherence to Anti-Money Laundering (AML), Know Your Customer (KYC) and consumer protection laws, while also defending against cyber risks (Paleti, 2022; Shirvanporzour, 2025).

3. Challenges of Implementing AI in the Banking Sector

Artificial Intelligence literally contains the ability to deal with a huge amount of routine banking tasks with high accuracy, but properly handling is the pivotal issue in this context. All machine learning programmes access different databases to enrich their own dataset to ensure the best response. In this context, the banking industry is facing plenty of challenges that slow down its widespread adoption. Pivotal fears in this context are data privacy and security as financial institutions handle highly valuable and sensitive customer information like usernames, account numbers and passwords that could be exposed to cyberattacks or unauthorized access if not adequately protected (Paul *et al.*, 2023; Wang *et al.*, 2024). Again, a burning issue is algorithmic bias, where AI models trained on incomplete or tilted datasets may produce discriminatory outcomes, such as one-sided lending decisions or exclusion of weak groups from financial services (Oguntibeju, 2024). In addition, the development and adoption of pro-AI systems like explainable AI requires substantial financial and technical investment, making high implementation costs a barrier, especially for smaller banks and institutions in third-world countries or developing economies (Aderibigbe *et al.*, 2023). Legal bindings further complicate the scenario, since the absence of clear, standardized guidelines regarding AI’s use in financial services creates hesitation among banks and increases compliance risks (Kothandapani, 2025; Truby *et al.*, 2020). Finally, accountability, transparency and trust remain critical challenges; the “black-box” nature of many AI models makes it difficult to explain how decisions are made, raising concerns among regulatory agencies, customers and bank authorities about accountability and fairness (Chaudhary, 2024; Thiruma Valavan, 2023). This type of hurdle underscores the need for robust regulatory frameworks, greater transparency in AI model design and strategies that balance technological efficiency with ethical and sustainable practices in banking.

Besides regulatory alignment and operational difficulties, there are also digital literacy and reliability enhancement issues. Many AI systems, particularly deep learning models, operate as “black boxes” making it difficult for regulators, managers and even customers to understand how decisions are made (Chaudhary, 2024; Thiruma Valavan, 2023). This lack of explainability hampers accountability and reduces customer confidence in AI-driven services. Again, AI consists of complex programming languages that are literally tough for end users such as bank employees or customers. As a result, integration of AI into legacy banking systems presents technical difficulties, often requiring significant restructuring of existing IT infrastructure (Hentzen *et al.*, 2022; Roy *et al.*, 2025). Considering all the issues in a place, these challenges underscore that the way to AI-driven banking is neither simple nor linear. To overcome all mentioned hurdles requires a combination of strong governance frameworks, regulatory simplicity, technological innovation and human AI collaboration models to ensure that AI enhances efficiency and sustainability without compromising ethical standards or financial steadiness (Mei *et al.*, 2024).

4. Opportunities to Ensure Long-Term and Sustainable Banking through AI Implementation

In cases of opportunities, the role of Machine Learning in the banking sector is remarkable to assist in different financial services with sustainable goals, helping organizations in gaining equal profitability with environment, social and governance considerations (Elhady & Shohieb, 2025). Implementing Machine Learning tools for green banking practices in financial institutions can grow fast compared with traditional banking via more inclusive and robust engagement in banking as well as in the entire economy (Rane *et al.*, 2024b). First, AI enables green finance and responsible lending by improving the identification and evaluation of environmentally sustainable projects (Hemanand *et al.*, 2022; Narayanan, 2025). Machine learning replicas can analyse vast datasets from corporate discoveries to satellite imagery to assess a borrower’s environmental footprint, carbon emissions and compliance with sustainability standards (Pattnaik *et al.*, 2024). This ultimately enhances better allocation of capital toward circular economy initiatives, renewable energy, energy efficiency and thereby strengthening banks’ roles in financing the low-carbon transition (Dewasiri *et al.*, 2023).

AI technologies are increasingly valuable in assessing potential risks to internal management, social and environmental factors. Backdated risk assessment methods cannot nowadays judge the potential risk in financial transactions and depend intensively on human expertise. As a result, traditional methods often fail to detect sustainable environmental risks such as resource insufficiency, climate change, or natural disasters (Aziz & Andriansyah, 2023; Tian, 2024). Machine Learning powered predictive analytics can model climate settings, stress test loan portfolios and identify

sectors that are most significant to environmental shocks (Olanrewaju, 2025). This not only strengthens financial stability but also enhances regulatory compliance with frameworks like the Task Force on Climate-Related Financial Disclosures (TCFD). Third, AI enhances “financial inclusion,” which is a pivotal pillar of sustainable banking (Mei *et al.*, 2024). By leveraging other data sources such as mobile transactions, value payments and behavioural patterns, AI-powered credit recording systems can extend banking services to underserved populations who lack traditional credit histories (Faheem, 2021). This may promote inclusive development by empowering low-income families, women entrepreneurs and small businesses, particularly in emerging economies (Kothandapani, 2025).

The incorporation of Machine Learning into banking operations can significantly enhance operating sustainability within banks. Through smart energy management systems, process automation and adjusted resource utilization, banks can reduce their own carbon footprint and operational costs (Haleem *et al.*, 2022). For instance, ML applications can regulate energy consumption in physical branches, facilitate paperless workflows and improve digital service delivery, reducing the environmental impact of banking infrastructure (Alnaser *et al.*, 2023). In addition, Machine Learning provides opportunities to strengthen environmental, social and governmental broadcasting and transparency (Elhady & Shohieb, 2025). Natural language processing and big data analytics can mechanise the collection, confirmation, and analysis of ESG-related evidence, enabling more dependable sustainability disclosures and reducing the risk of greenwashing (Lim, 2024). These advancements not only improve stakeholder trust but also help investors and regulatory agencies make informed decisions. By leveraging its capabilities, institutions can transition from compliance-driven approaches toward proactively shaping a financial system that supports environmental stewardship, social equity and long-term economic resilience (Mohammed *et al.*, 2024).

5. METHODOLOGY

This article follows the PRISMA framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to ensure reliability, transparency and rigor in identifying and analyzing the previous literature on AI applications, challenges and opportunities in the sustainable banking sector. PRISMA provides a structured approach that documents how studies are identified, screened, assessed for eligibility and finally included in the review. For instance, Fares, Wijethilake (2025) applied this approach in their systematic literature review, outlining strategic, processual and customer-centric themes and proposing an AI banking service framework. Similarly, Ndukwe and Baridam (2023) and AL-Dosari *et al.*, (2024) used thematic analysis to examine AI’s role in cyber-threat intelligence, revealing a lack of research on regional applications, particularly in African banks. Lo and Farayola *et al.*, (2023) extended this method to AI-focused business models, identifying themes of effectiveness, data-driven decision formulation and customer focus, thereby illustrating the transformative yet challenging impact of AI on traditional banking strategies.

A comprehensive search was conducted across three leading databases, such as Scopus, ScienceDirect and Google Scholar, using carefully selected keywords such as “Artificial Intelligence,” “Machine Learning,” “Natural Language Processing,” “sustainable banking,” “Green Finance,” “Ethical Banking” and “ESG Banking.” The initial search produced 879 documents spanning the period 2016 to 2025. After removing duplicates and excluding non-English papers, conference proceedings, book chapters and incomplete drafts, 334 journal articles remained. This ensured the focus remained on peer-reviewed and high-quality publications. The remaining articles were further assessed based on inclusion criteria: (i) publication in the period from 2016 to 2025, (ii) relevance to AI applications in sustainability, ethics, or digital banking and (iii) final publication stage. At this stage, a large proportion of general AI or purely technical papers without banking or sustainability linkage were excluded. After applying the eligibility filters, 58 high-quality studies were selected for in-depth thematic analysis. These final studies provided direct insights into AI applications in sustainable banking, associated challenges and future research opportunities.

Table 1: Flowchart for Literature Selection

SPAR-4-SLR (PRISMA)	Consideration	Decision
Assembling (Identification)	Search Focus	AI Applications in Sustainable Banking Performance
	Search Keywords	Artificial Intelligent
		Machine Learning
		Natural Language Processing
		Sustainable Banking
		Green Finance
		Ethical Banking
		ESG Banking
	Search Database	Scopus, Science Direct, Google Scholar
	Search Field	Article title, Abstract and Keywords
	Search Result	879 Documents
	Search Period	2016 to 2025

SPAR-4-SLR (PRISMA)	Consideration	Decision
Arranging (Screening and Eligibility)	Subject Area	'Artificial Intelligence', 'Sustainability', 'Digital Literacy', 'Ethical Issues', 'Legal framework'
	Document type	'Article' 378
	Publication Stage	'Final' 369
	Source Type	'Journal' 361
	Language	'English' 334
	Developing Nation	"Bangladesh, India, Pakistan, China, Sri Lanka, etc. " 58
	Search Results	58 Documents

6. IMPLICATION AND CONCLUSION

Artificial Intelligence is no longer a minor tool in the banking sector, offering transformative applications that improve operational efficiency, creating tangible opportunities to promote environmental sustainability, reinforce threat control and endorse financial inclusion and supervisory compliance. This analysis emphasises the multi-layered applications of AI in sustainable banking, ranging from risk assessment, scam recognition and credit scoring to ESG performance nursing, green finance product development and predictive analytics for environmental and social consequences. By leveraging AI, banks can more precisely measure environmental and social risks, optimize resource allocation and support regulatory compliance while concurrently delivering value to customers and investors. For instance, AI-enabled credit scoring systems can extend financial services to unbanked populations, while predictive analytics can assimilate climate jeopardy into lending decisions, thus supporting the environmental and social dimensions of banking.

For practitioners and bank managers, the results underscore the necessity to view AI as a strategic enabler rather than just a high-tech instrument. The banking industry needs to invest money to build up AI infrastructure, talent improvement and explainable AI systems to ensure that sustainability objectives are incorporated into their digital transformation policies. For policymakers and regulators, the review emphasizes the urgency of establishing clear, forward-looking guidelines to balance innovation with ethical safeguards, particularly in areas such as data privacy, algorithmic bias and accountability. This is particularly critical for developing economies, where AI can act as a catalyst for inclusive and sustainable growth if properly regulated. For researchers and academicians, the paper delivers a structured framework that detects both the present gaps in understanding and probable future directions, such as the alignment of Artificial Intelligence with Environmental, Social and Governmental metrics and the role of human and Artificial Intelligence collaboration in sustainable banking ecosystems.

To sum up, Artificial Intelligence has the potential to redefine the forms of sustainable banking by entrenching Environmental, Social and Governance philosophies into decision-making, improving accountability and driving invention. However, realizing this potential entails addressing challenges connected to governance, ethics and execution charges. The corridor forward lies in fostering a joint ecosystem among banks, regulatory agencies, technology providers and civil society to confirm that AI adoption is both responsible and impactful. Ultimately, Artificial Intelligence should be situated not only as a tool for digital conversion but also as a foundation for building an inclusive, resilient and sustainable financial ecosystem.

7. Limitations and Future Research Directions

Despite these opportunities, this paper is subject to certain limitations that must be acknowledged. First, the scope of the review was restricted to publications indexed in Scopus, Web of Science and Google Scholar, which, although widely regarded as reliable and comprehensive, may exclude relevant research available in other databases, industry reports, or regional studies. Second, most of the existing literature on AI in sustainable banking remains conceptual or exploratory in nature, with limited empirical validation and cross-country comparative analyses. This restricts the generalizability of insights, especially when considering the diverse regulatory, cultural and technological contexts across developed and developing economies. Third, the rapidly evolving nature of AI technologies means that the findings presented here may quickly become outdated as new applications, frameworks and ethical challenges emerge. Finally, while this study categorized AI applications into thematic areas, overlaps across themes may exist, which could be further disentangled with more granular methodologies such as meta-analysis or advanced bibliometric mapping.

Building on these limitations, future research can explore several promising directions. First, future research can extend to empirical studies that quantify the impact of AI adoption on sustainable banking outcomes, such as ESG performance, financial inclusion and environmental risk management. Longitudinal and cross-country studies could shed light on how institutional, cultural and regulatory environments shape AI's role in promoting sustainability. Second, future research should examine the ethical and governance dimensions of AI in greater depth, particularly focusing on algorithmic fairness, transparency and accountability mechanisms that can align AI adoption with sustainable development goals (SDGs). Third, the intersection of AI and ESG measurement presents a rich avenue for research, where AI could be used to improve the quality, comparability and credibility of ESG reporting. Fourth, scholars should investigate the human and

AI collaboration models in banking, examining how reskilling, organizational design and employee engagement can ensure that technological adoption complements rather than displaces the workforce. Finally, interdisciplinary approaches combining insights from computer science, finance, sustainability studies and regulatory policy will be crucial to developing holistic frameworks for responsible AI adoption in banking. In summary, while this review provides a foundation for understanding the opportunities and challenges of AI in sustainable banking, there is ample scope for future research to deepen, broaden and empirically validate these insights. Addressing these gaps will not only enrich academic discourse but also guide practitioners and policymakers in leveraging AI responsibly to build a more inclusive and sustainable financial ecosystem.

REFERENCES

- Abiagom, C. N., & Ijomah, T. I. (2024). Enhancing customer experience through AI-driven language processing in service interactions. *Open access research journal of engineering and technology*, 7(1), 014-021.
- Abramova, A. (2024). Environmental, Social and Governance (ESG) Principles in the Banking Sector. Development, Integration and Risk Management Strategies: a case study of a Finnish banks' approach to ESG Framework.
- Adekunle, B. I., Chukwuma-Eke, E. C., Balogun, E. D., & Ogunsola, K. O. (2023). Integrating AI-driven risk assessment frameworks in financial operations: A model for enhanced corporate governance. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, 9(6), 445-464.
- Aderibigbe, A. O., Ohenhen, P. E., Nwaobia, N. K., Gidiagba, J. O., & Ani, E. C. (2023). Artificial intelligence in developing countries: Bridging the gap between potential and implementation. *Computer Science & IT Research Journal*, 4(3), 185-199.
- Afroogh, S., Akbari, A., Malone, E., Kargar, M., & Alambeigi, H. (2024). Trust in AI: progress, challenges and future directions. *Humanities and Social Sciences Communications*, 11(1), 1-30.
- Alakotila, J. (2023). Employee Experience and Organisational Readiness in a Change Process Towards AI-powered Customer-Oriented Marketing, Case: Company X.
- AL-Dosari, K., Fetais, N., & Kucukvar, M. (2024). Artificial intelligence and cyber defense system for banking industry: A qualitative study of AI applications and challenges. *Cybernetics and systems*, 55(2), 302-330.
- Alnaser, F. M., Rahi, S., Alghizzawi, M., & Ngah, A. H. (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(8).
- Alonge, E. O., Eyo-Udo, N. L., CHIBUNNA, B., UBANADU, A. I. D., BALOGUN, E. D., & OGUNSOLA, K. O. (2021). Digital transformation in retail banking to enhance customer experience and profitability. *Iconic Research And Engineering Journals*, 4(9).
- Alsoukuni, F. A. M., Adedokun, M. W., & Berberoğlu, A. (2025). Enhancing Sustainable Innovation Performance in the Banking Sector of Libya: The Impact of Artificial Intelligence Applications and Organizational Learning. *Sustainability*, 17(12), 5345.
- Appachikumar, A. K. (2025). AI in Fraud Detection: Transforming Risk Management in Banking. *International Journal of Integrated Research and Practice*, 55-65.
- Arshad, M., Hameed, K., & Naem, H. M. (2025). Exploring the Role of AI in Shaping Human Competencies and Workforce Development. *Social Science Multidisciplinary Review*, 39-63.
- Aziz, L. A.-R., & Andriansyah, Y. (2023). The role artificial intelligence in modern banking: an exploration of AI-driven approaches for enhanced fraud prevention, risk management and regulatory compliance. *Reviews of Contemporary Business Analytics*, 6(1), 110-132.
- Chakraborty, T., Sharada, V., & Sai, S. D. D. (2025). Transactions to Relationship: Customers Engagement in the Digital Age. In *Managing Customer-Centric Strategies in the Digital Landscape* (pp. 25-50). IGI Global.
- Challa, S. R. (2023). Artificial Intelligence and Big Data in Finance: Enhancing Investment Strategies and Client Insights in Wealth Management.
- Challoumis, C. (2024). The Imperative of Skill Development in an AI Revolution. XIX International Scientific Conference. London. Great Britain,
- Chaudhary, G. (2024). Unveiling the black box: Bringing algorithmic transparency to AI. *Masaryk University Journal of Law and Technology*, 18(1), 93-122.
- Dewasiri, N. J., Karunarathne, K. S. S. N., Menon, S., Jayarathne, P. G. S. A., & Rathnasiri, M. S. H. (2023). Fusion of artificial intelligence and blockchain in the banking industry: Current application, adoption and future challenges. In *Transformation for sustainable business and management practices: Exploring the spectrum of industry 5.0* (pp. 293-307). Emerald Publishing Limited.
- Dzureke, S. S. (2025). Preventing complaints before they happen: How AI-driven sentiment analysis enables proactive service recovery. *Advanced Research Journal*.
- El Hajj, M., & Hammoud, J. (2023). Unveiling the influence of artificial intelligence and machine learning on financial markets: A comprehensive analysis of AI applications in trading, risk management and financial operations. *Journal of Risk and Financial Management*, 16(10), 434.

- Elhady, A. M., & Shohieb, S. (2025). AI-driven sustainable finance: computational tools, ESG metrics and global implementation. *Future Business Journal*, 11(1), 209.
- Faheem, M. A. (2021). AI-driven risk assessment models: Revolutionizing credit scoring and default prediction. *Iconic Research And Engineering Journals*, 5(3), 177-186.
- Farayola, O. A., Abdul, A. A., Irabor, B. O., & Okeleke, E. C. (2023). Innovative business models driven by AI technologies: A review. *Computer Science & IT Research Journal*, 4(2), 85-110.
- Fares, O. H., Butt, I., & Lee, S. H. M. (2022). Utilization of artificial intelligence in the banking sector: a systematic literature review. *Journal of Financial Services Marketing*, 1.
- Favour, A., Kunle, A., Oladele, S., & Timileyin, J. (2025). The Role of Natural Language Processing (NLP) in Enhancing Customer Experience in Fintech: Applications in Chatbots and Virtual Assistants.
- Fernandes, S., Sheeja, M., & Parivara, S. (2024). Potential of AI for a sustainable, inclusive and ethically responsible future. *Fostering Multidisciplinary Research for Sustainability*, 196.
- Ghosn, F. (2025). Artificial Intelligence in Investment and Wealth Management. In *AI's Transformative Impact on Finance, Auditing and Investment* (pp. 1-42). IGI Global Scientific Publishing.
- Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of intelligent networks*, 3, 119-132.
- Hemanand, D., Mishra, N., Premalatha, G., Mavaluru, D., Vajpayee, A., Kushwaha, S., & Sahile, K. (2022). Applications of intelligent model to analyze the green finance for environmental development in the context of artificial intelligence. *Computational Intelligence and Neuroscience*, 2022(1), 2977824.
- Hentzen, J. K., Hoffmann, A., Dolan, R., & Pala, E. (2022). Artificial intelligence in customer-facing financial services: a systematic literature review and agenda for future research. *International Journal of Bank Marketing*, 40(6), 1299-1336.
- Ibrahim, A., Almasria, N. A., Alhatabat, Z. A., Ershaid, D. J. A., & Aldboush, H. H. (2025). Transforming Financial Services With Artificial Intelligence and Machine Learning: Insights Into Opportunities and Emerging Trends. *Utilizing AI and Machine Learning in Financial Analysis*, 129-148.
- Igwe-Nmaju, C., Gbaja, C., & Ikeh, C. O. (2023). Redesigning customer experience through AI: a communication-centered approach in telecoms and tech-driven industries. *International Journal of Science and Research Archive*.
- Javaid, H. A. (2024). Improving fraud detection and risk assessment in financial service using predictive analytics and data mining. *Integrated Journal of Science and Technology*, 1(3).
- Kayed, S., Alta'any, M., Meqbel, R., Khatatbeh, I. N., & Mahafzah, A. (2025). Bank FinTech and bank performance: evidence from an emerging market. *Journal of Financial Reporting and Accounting*, 23(2), 518-535.
- Khan, A., Jhanjhi, N., Ali, G. A., Ray, S. K., & Wassan, S. (2025). Case Studies and Applications of Generative AI in Real-World Cybersecurity Scenarios.
- Khan, M. A. M., & Islam, R. Aspects of Risk Management in Banking Sector of Bangladesh.
- Kothandapani, H. P. (2025). Ai-driven regulatory compliance: Transforming financial oversight through large language models and automation. *Emerging Science Research*, 12(1), 12-24.
- Kovvuri, V. K. R. (2024). AI in banking: Transforming customer experience and operational efficiency. *International Journal for Multidisciplinary Research*. [Online].
- Kumar, T. V. (2020). Generative AI Applications in Customizing User Experiences in Banking Apps.
- Lim, T. (2024). Environmental, social and governance (ESG) and artificial intelligence in finance: State-of-the-art and research takeaways. *Artificial Intelligence Review*, 57(4), 76.
- Limajatini, L., Suhendra, S., Pangilinan, G. A., & Ilham, M. G. (2025). Integration of Artificial Intelligence in the Financial Sector Innovation, Risks and Opportunities. *International Journal of Cyber and IT Service Management*, 5(1), 58-70.
- Lubis, L. S., & Sembiring, D. E. (2023). Driving digital transformation: leveraging robotic process automation (rpa) to enhance business process efficiency and reducing manual errors. 2023 IEEE International Conference on Data and Software Engineering (ICoDSE),
- Manta, O., Vasile, V., & Rusu, E. (2025). Banking Transformation Through FinTech and the Integration of Artificial Intelligence in Payments. *FinTech*, 4(2), 13.
- Masum Miah, M., Khan, A. M., & Rahman, M. (2012). Recent trends of international migration and remittance flows: An empirical evidence of Bangladesh. *Bangladesh Economic Review*, 441, 36-18.
- Megargel, A., Shankaraman, V., & Arul, O. K. (2025). Transformation of digital banking back-office operations using AI. In *Handbook of Blockchain, Digital Finance and Inclusion, Volume 3* (pp. 183-198). Elsevier.
- Mei, H., Bodog, S.-A., & Badulescu, D. (2024). Artificial intelligence adoption in sustainable banking services: the critical role of technological literacy. *Sustainability*, 16(20), 8934.
- Mercier-Laurent, E. (2021). Can artificial intelligence effectively support sustainable development? IFIP International Workshop on Artificial Intelligence for Knowledge Management,

- Met, İ., Kabukçu, D., Uzunoğulları, G., Soyalp, Ü., & Dakdevir, T. (2019). Transformation of business model in finance sector with artificial intelligence and robotic process automation. In *Digital business strategies in blockchain ecosystems: Transformational design and future of global business* (pp. 3-29). Springer.
- Mohammed, K. S., Serret, V., Jabeur, S. B., & Nobanee, H. (2024). The role of artificial intelligence and fintech in promoting eco-friendly investments and non-greenwashing practices in the US market. *Journal of Environmental Management*, 359, 120977.
- Moharrak, M., & Mogaji, E. (2025). Generative AI in banking: empirical insights on integration, challenges and opportunities in a regulated industry. *International Journal of Bank Marketing*, 43(4), 871-896.
- Mondal, U., Hossain, M. S., & Khan, M. A. M. (2015). School banking: a new idea of banking operation in Bangladesh. *International Journal of Science and Research*, 4(11), 1926-1931.
- Narayanan, M. (2025). Trends and Artificial Intelligence Development of Banking Sector: Social Implication of Green Banking Initiatives. *Waste Management*, 15(20), 30.
- Narender, M., & Anand, A. J. (2025). Artificial Intelligence in Financial Fraud Detection. In *Handbook of AI-Driven Threat Detection and Prevention* (pp. 193-207). CRC Press.
- Ndukwe, E. R., & Baridam, B. (2023). A graphical and qualitative review of literature on ai-based cyber-threat intelligence (cti) in banking sector. *European Journal of Engineering and Technology Research*, 8(5), 59-69.
- Nithya, M. (2024). Revolutionizing Customer Experience with AI-Powered Chat bots and Virtual Assistants. 2024 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSSES),
- Ochieng, C. (2024). *Exploring Strategies Financial Services Business Leaders Use to Effectively Integrate Emerging Technologies to Drive Revenue Growth* Walden University].
- Oguntibeju, O. O. (2024). Mitigating artificial intelligence bias in financial systems: A comparative analysis of debiasing techniques. *Asian Journal of Research in Computer Science*, 17(12), 165-178.
- Oko-Odion, C. (2025). AI-Driven Risk Assessment Models for Financial Markets: Enhancing Predictive Accuracy and Fraud Detection. *International Journal of Computer Applications Technology and Research*, 14(04), 80-96.
- Olanrewaju, A. G. (2025). Artificial Intelligence in Financial Markets: Optimizing Risk Management, Portfolio Allocation and Algorithmic Trading. *International Journal of Research Publication and Reviews*, 6, 8855-8870.
- Onabowale, O. (2024). The rise of AI and Robo-Advisors: Redefining financial strategies in the digital age. *International Journal of Research Publication and Reviews*, 6.
- Paleti, S. (2022). Adaptive AI In Banking Compliance: Leveraging Agentic AI For Real-Time KYC Verification, Anti-Money Laundering (AML) Detection And Regulatory Intelligence. *Anti-Money Laundering (AML) Detection And Regulatory Intelligence* (December 20, 2022).
- Pan, S. L., & Nishant, R. (2023). Artificial intelligence for digital sustainability: An insight into domain-specific research and future directions. *International Journal of Information Management*, 72, 102668.
- Paramesha, M., Rane, N., & Rane, J. (2024). Artificial intelligence, machine learning, deep learning and blockchain in financial and banking services: A comprehensive review. *Machine Learning, Deep Learning and Blockchain in Financial and Banking Services: A Comprehensive Review* (June 6, 2024).
- Patil, D. (2024). Artificial intelligence-driven customer service: enhancing personalization, loyalty and customer satisfaction. *Loyalty And Customer Satisfaction* (November 20, 2024).
- Pattnaik, D., Ray, S., & Raman, R. (2024). Applications of artificial intelligence and machine learning in the financial services industry: A bibliometric review. *Heliyon*, 10(1).
- Paul, E., Callistus, O., Somtobe, O., Esther, T., Somto, K., Clement, O., & Ejimofor, I. (2023). Cybersecurity strategies for safeguarding customer's data and preventing financial fraud in the United States financial sectors. *International Journal on Soft Computing*, 14(3), 01-16.
- Perera, K. (2025). Influence on Employee Productivity and Job Satisfaction in the Dynamics of Human-AI Collaboration in Modern Work Environments Among Service Sector Organizations in Sri Lanka. *International Journal of Contemporary Business Research*, 3(2).
- Piacentino, L. (2025). *The Transformative Role of Artificial Intelligence in Financial Decision-Making: Main Applications in Corporate and Personal Finance, Impacts and Future Prospects* Politecnico di Torino].
- Rahman, M. M., Hamid, M. K., & Khan, M. A. M. (2015). Determinants of bank profitability: Empirical evidence from Bangladesh. *International journal of business and management*, 10(8), 135.
- Rahman, M. S., Moral, I. H., Kaium, M. A., Sarker, G. A., Zahan, I., Hossain, G. M. S., & Khan, M. A. M. (2024). FinTech in sustainable banking: An integrated systematic literature review and future research agenda with a TCCM framework. *Green Finance*, 6(1), 92-116.
- Rahman, M., Ming, T. H., Baigh, T. A., & Sarker, M. (2023). Adoption of artificial intelligence in banking services: an empirical analysis. *International Journal of Emerging Markets*, 18(10), 4270-4300.
- Rahmani, F. M., & Zohuri, B. (2023). The transformative impact of AI on financial institutions, with a focus on banking. *Journal of Engineering and Applied Sciences Technology*. SRC/JEAST-279. DOI: doi.org/10.47363/JEAST/2023 (5), 192, 2-6.

- Rane, N., Choudhary, S., & Rane, J. (2024a). Artificial intelligence (AI), internet of things (IoT) and blockchain-powered chatbots for improved customer satisfaction, experience and loyalty. *Internet of Things (IoT) and blockchain-powered chatbots for improved customer satisfaction, experience and loyalty* (May 29, 2024).
- Rane, N., Choudhary, S., & Rane, J. (2024b). Artificial intelligence driven approaches to strengthening Environmental, Social and Governance (ESG) criteria in sustainable business practices: a review. *Social and Governance (ESG) criteria in sustainable business practices: a review* (May 27, 2024).
- Rani, S., Singh, R., & Khang, A. (2025). Artificial Intelligence (AI) and Data Analytics: A New Era in the Financial Industry. In *Shaping Cutting-Edge Technologies and Applications for Digital Banking and Financial Services* (pp. 96-105). Productivity Press.
- Rodrigues, A. R. D., Ferreira, F. A., Teixeira, F. J., & Zopounidis, C. (2022). Artificial intelligence, digital transformation and cybersecurity in the banking sector: A multi-stakeholder cognition-driven framework. *Research in International Business and Finance*, 60, 101616.
- Roy, P., Ghosh, S., Podder, A., & Sarkar, S. K. (2025). Opportunities and challenges of Artificial intelligence (AI) in the banking and finance sector. *Shaping Cutting-Edge Technologies and Applications for Digital Banking and Financial Services*, 120-137.
- Saba, T., Hubert, A.-M., & Bernet, M. (2025). Shaping Human Capital Standards: Exploring the Intersections of the Future of Work and Artificial Intelligence.
- Salinas, G. A. M. (2024). *Assessment of the efficiency of investment robo-advisory* Vilniaus universitetas.].
- Sharma, G. M., Gaur, P., Luu, T. M. N., & Najeeb, A. (2025). AI and the Evolution of Knowledge Work: Revolutionizing Professional Services With Automation. In *Global Work Arrangements and Outsourcing in the Age of AI* (pp. 255-268). IGI Global Scientific Publishing.
- Sheth, J. N., Jain, V., Roy, G., & Chakraborty, A. (2022). AI-driven banking services: the next frontier for a personalised experience in the emerging market. *International Journal of Bank Marketing*, 40(6), 1248-1271.
- Shirvanporzour, A. (2025). Artificial Intelligence in Banking Risk Management and Anti-Money Laundering: A Comprehensive Review. Available at SSRN 5161209.
- Spring, M., Faulconbridge, J., & Sarwar, A. (2022). How information technology automates and augments processes: Insights from Artificial-Intelligence-based systems in professional service operations. *Journal of Operations Management*, 68(6-7), 592-618.
- Strielkowski, W., Grebennikova, V., Lisovskiy, A., Rakhimova, G., & Vasileva, T. (2025). AI-driven adaptive learning for sustainable educational transformation. *Sustainable Development*, 33(2), 1921-1947.
- Sultana, R., & Faisal, N. A. (2024). The Role Of Digital Banking Features In Bank Selection An Analysis Of Customer Preferences For Online And Mobile Banking. Available at SSRN 5049165.
- Sundharesalingam, P., Somasundaram, R., Sushmitha, S., Rithanya, R., & Archana, M. (2023). AI Enhanced FinTech Strategies for Driving ESG Investments in Sustainable Finance. International Conference on Soft Computing and Pattern Recognition,
- Thiruma Valavan, A. (2023). AI Ethics and Bias: Exploratory study on the ethical considerations and potential biases in ai and data-driven decision-making in banking, with a focus on fairness, transparency and accountability. *World Journal of Advanced Research and Reviews*, 20(2), 197-206.
- Thomas, M., Maheswari, G., & Kavitha, M. (2025). AI applications in sustainable financial management. *Revista Espanola de Derecho Canonico*, 7(1), 58-71.
- Tian, X. (2024). The Role of Artificial Intelligence in the Digital Transformation of Commercial Banks: Enhancing Efficiency, Customer Experience and Risk Management. SHS Web of Conferences,
- Truby, J., Brown, R., & Dahdal, A. (2020). Banking on AI: mandating a proactive approach to AI regulation in the financial sector. *Law and Financial Markets Review*, 14(2), 110-120.
- Turksen, U., Benson, V., & Adamyk, B. (2024). Legal implications of automated suspicious transaction monitoring: enhancing integrity of AI. *Journal of Banking Regulation*, 25(4), 359-377.
- Ul Huq, S. M., Khan, A. M., & Rahman, H. (2016). FDI and Bangladesh: A study of South Asian territories. *Management Studies and Economic Systems*, 2(3), 219-239.
- Valavanidis, A. (2023). Artificial intelligence (ai) applications. *Department of Chemistry, National and Kapodistrian University of Athens, University Campus Zografou*, 15784.
- Van Vliet, B. (2023). Cryptocurrency Anti-Money Laundering (AML) and Know-Your-Customer (KYC) Management System Standard—Requirements. *Journal of Payments Strategy and Systems*.
- Vashishth, T. K., Sharma, V., Sharma, K. K., Kumar, B., Kumar, A., & Panwar, R. (2024). Artificial intelligence (AI)–powered chatbots: Providing instant support and personalized recommendations to guests 24/7. In *Technology and Luxury Hospitality* (pp. 211-236). Routledge.
- Vasile, V., & Manta, O. (2025). FinTech and AI as Opportunities for a Sustainable Economy. *FinTech*, 4(2), 10.
- Wang, M., Zhao, Q., & Gong, X. (2025). Does banking relationships promote environmental, social and governance performance? Empirical evidence from A-share listed firms in China. *Managerial and Decision Economics*.

- Wang, S., Asif, M., Shahzad, M. F., & Ashfaq, M. (2024). Data privacy and cybersecurity challenges in the digital transformation of the banking sector. *Computers & security*, 147, 104051.
- Wijethilake, C. (2025). Ethical challenges in utilizing Artificial Intelligence in banking operations: A systematic review.
- Wu, Z., Li, L., Wang, B., & Zhang, X. (2024). FinTech regulation and banks' risk-taking: Evidence from China. *PloS one*, 19(10), e0311722.
- Yang, M., Wider, W., Xiao, S., Jiang, L., Fauzi, M. A., & Lee, A. (2024). Unveiling current and future trends in customer banking experience research: a bibliometric analysis. *Kybernetes*.
- Yenduri, G., Ramalingam, M., Selvi, G. C., Supriya, Y., Srivastava, G., Maddikunta, P. K. R., Raj, G. D., Jhaveri, R. H., Prabadevi, B., & Wang, W. (2024). Gpt (generative pre-trained transformer)—A comprehensive review on enabling technologies, potential applications, emerging challenges and future directions. *IEEE Access*, 12, 54608-54649.
- Yıldız, E., & Demir, Z. (2024). The Impact of Artificial Intelligence on Financial Inclusion: Data-Driven Approaches for Expanding Access to Banking in Underserved Regions. *International Journal of Advanced Theoretical and Applied Computer Science Research, Innovations and Applications*, 14(7), 1-16.
- Zha, R. K. S. S., & Mitra, D. (2024). Empowering Financial Decisions with AI: Optimizing Strategies for Financial Planning and Wealth Management. *Drishtikon: A Management Journal*, 15(2).
- Zhang, Z., Al Hamadi, H., Damiani, E., Yeun, C. Y., & Taher, F. (2022). Explainable artificial intelligence applications in cyber security: State-of-the-art in research. *IEEE Access*, 10, 93104-93139.
- Zheng, C., Chowdhury, M. M., Khan, M. A. M., & Gupta, A. D. (2023). Effects of ownership on the relationship between bank capital and financial performance: evidence from Bangladesh. *International Journal of Research in Business and Social Science* (2147-4478), 12(9), 260-274.
- Zheng, C., Khan, M. A. M., Islam, R., & Chowdhury, M. M. (2025). Exploring the relationship between ESG performance and firm value in Chinese and US banks: The moderating impact of environmental uncertainty and competitive advantage. *International Journal of Research in Business and Social Science*, 14(1), 1-16.
- Zheng, C., Khan, M. A. M., Rahman, M. M., Sadeque, S. B., & Islam, R. (2023). The impact of monetary policy on banks' risk-taking behavior in an emerging economy: The role of Basel II. *Data Science in Finance and Economics*, 3(4), 427-451.
- Zheng, C., Rahman, M. A., Hossain, S., & Moudud-Ul-Huq, S. (2023). Does Fintech-Driven Inclusive Finance Induce Bank Profitability? Empirical Evidence from Developing Countries. *Journal of Risk and Financial Management*, 16(10), 457.