



AI and Blockchain in Finance: Opportunities and Challenges for the Banking Sector

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Abstract: Blockchain technology and artificial intelligence (AI) have been gaining much interest in the finance industry due to their potential to democratize access to financial services, especially in impoverished areas lacking traditional banking infrastructure. The current study adopts a research strategy that thoroughly examines and integrates existing literature on the convergence of AI and blockchain technologies within the banking sector. The strategy combines qualitative and quantitative methods to deliver a holistic understanding of the integration's advantages and limitations of blockchain technology and AI in banking. The data is subjected to qualitative content analysis to identify recurring themes, trends, and linkages in the literature. Blockchain technology offers inherent security features, such as encryption and cryptographic hashing, but also introduces new privacy challenges. Security and privacy issues necessitate the deployment of strong encryption protocols, access controls, and data anonymization techniques that protect sensitive data and ensure regulatory compliance. Integrating blockchain and AI offers significant opportunities for enhancing the risk management processes in supply chain finance, enabling real-time tracking, transparency, and optimization of supply chain processes. AI-driven algorithms improve fraud detection and risk management, allowing financial institutions to spot unusual trends and proactively reduce risks. This paper attempts to promote discussion on possible applications and help readers make well-informed decisions on the future of finance in a blockchain-enabled, artificial intelligence-driven world by looking at real-life instances.

Keywords: Blockchain Technology, Artificial Intelligence (AI), Finance, Risk Management, Supply Chain.

I. INTRODUCTION

The financial industry is leading the way in this revolution as blockchain technology and artificial intelligence (AI) combine to revolutionize many other industries. Blockchain, with its decentralized and unchangeable ledger system, and AI, with its ability to analyze and make complex data decisions, present many prospects for innovation and efficiency improvements in the financial services industry. Comprehending these technologies' interplay and possible consequences is crucial for stakeholders maneuvering through the swiftly changing financial technology terrain.

A. Background Information on Artificial Intelligence and Blockchain Technologies

Artificial Intelligence describes various techniques that enable systems to simulate cognitive functions like knowledge, reasoning, and problem-solving. To enhance decision-making processes, artificial intelligence (AI) has shown itself to be extraordinarily skilled at analyzing massive amounts of data and extracting valuable information. Deep learning, machine learning, and natural language processing are some of the uses of AI [1].

Conversely, blockchain technology first appeared as the underlying framework of cryptocurrencies, most notably Bitcoin, but it has since developed into a flexible instrument with uses not limited to virtual money. Fundamentally, blockchain is a tamper-proof, decentralized ledger system that facilitates safe, open transactions without intermediaries [2]. However, while blockchain can improve KYC compliance, it also brings new types of security threats and challenges that must be addressed. The article suggests that banks need to evolve with blockchain innovations to stay ahead in the context of AML efforts [3]. Data integrity and resistance against tampering or unauthorized alterations are ensured by its dispersed nature.

B. Significance of integration with the finance sector:

The banking industry is data-driven by nature; risk management, fraud detection, and customer service are just a few functions that depend on precise and timely information. Financial organizations may unlock new possibilities to improve security, optimize procedures, and provide clients cutting-edge services by merging blockchain technology with artificial intelligence. For example, blockchain maintains the integrity and transparency of transaction records, while AI-powered algorithms may analyze large databases to find patterns suggestive of fraudulent activity.



Additionally, the combination of blockchain technology and artificial intelligence (AI) has the potential to democratize access to financial services, especially in impoverished areas lacking traditional banking infrastructure. Fintech startups and established institutions can reach previously unexplored markets and empower people with greater financial inclusion by utilizing blockchain for secure and transparent transactions and AI for personalized financial suggestions.

C. Purpose and Scope of the article:

Given the growing significance of both technologies, this article attempts to investigate the prospects and difficulties related to integrating blockchain and artificial intelligence (AI) in the finance sector. The paper thoroughly examines regulatory issues and developing trends to help industry experts, legislators, and researchers realize these game-changing technologies' full potential. This paper attempts to promote discussion on possible applications and help readers make well-informed decisions on the future of finance in a blockchain-enabled, AI-driven world by looking at real-life instances.

II. LITERATURE REVIEW

A. Overview of AI applications in finance

Artificial intelligence (AI), which provides advanced skills in data processing, predictive modeling, and decision-making, has revolutionized the banking sector on multiple occasions [1]. In the trade and investment arenas, AI-powered algorithms can assess risk factors, examine market trends, and carry out transactions quickly and accurately [1]. Through predictive models for fraud detection, credit scoring, and portfolio management, financial institutions can improve risk mitigation and hone investment strategies by leveraging machine learning approaches [1]. Furthermore, sentiment analysis of news articles, social media feeds, and financial reports is made easier using natural language processing algorithms, which offer insightful data for algorithmic trading and market sentiment analysis [1].

B. Overview of Blockchain applications in finance

Blockchain technology is gaining much interest in finance by answering persistent problems like efficiency, security, and transparency. "Blockchain—the decentralized replicated ledger technology that underlies Bitcoin and other cryptocurrencies—provides a potentially attractive alternative way to organize modern finance" [4]. Blockchain is widely used in the financial industry for payments and settlements, where distributed ledger technology allows for safe, almost immediate transactions without intermediaries [2].

Encrypted on the blockchain, smart contracts are programmable, self-executing contracts that automate several financial operations, including supply chain finance, insurance claims, and loan agreements [2]. Reducing administrative expenses and fraud risk are benefits of using blockchain technology to tokenize assets like equities, commodities, and real estate. It also improves the liquidity of these digital assets and allows fractional ownership.

C. Existing integration efforts and challenges

Integrating blockchain and artificial intelligence offers significant opportunities for enhancing the risk management processes in banks. While blockchain technology can help mitigate risks like money laundering and cyberattacks, and artificial intelligence can aid in analyzing vast amounts of unstructured data, adopting these technologies requires overcoming interoperability issues to ensure seamless data integration across various systems. In context, [5] suggests that banks are increasingly looking to leverage blockchain for its potential benefits, which include improving risk management functions.

Furthermore, the article indicates the potential for blockchain and AI to drive digitalization and automation within banking operations [5]. However, realizing these benefits necessitates evolving regulatory frameworks to handle new technologies' complex ethical and legal challenges, ensuring accountability and data protection. Collaborative efforts between industry participants and regulators are essential for creating scalable and enduring solutions that maximize blockchain and AI's advantages to the financial sector [5]. Hence, the banking industry must engage in standardization efforts and partnerships with regulators to address challenges associated with technology integration, such as compliance with legal frameworks and technical issues, to harness the full potential of these innovative technologies [5].

III. THEORETICAL FRAMEWORK

A. Conceptual understanding of AI and blockchain integration

Artificial Intelligence and blockchain technology integration in the financial industry is a powerful merger poised to reshape established financial institutions radically. AI leverages computational models and algorithms to interpret extensive data, providing insights and automating complex decision-making processes.



Blockchain technology, on the other hand, delivers a decentralized and immutable ledger system that ensures transactional integrity, transparency, and security without intermediaries [2]. When brought together, AI and blockchain offer a groundbreaking solution that could significantly enhance the efficacy, transparency, and security of operations in the financial sector.

In finance, AI's predictive analytics, machine learning, and natural language processing capabilities are utilized to derive meaningful insights from financial data. These insights facilitate informed risk assessment, portfolio management, and fraud detection decisions. Meanwhile, blockchain technology ensures a robust and transparent framework, enabling traceable, auditable, and tamper-proof financial transactions. By integrating AI with blockchain technology, financial institutions can streamline operations, reduce costs, mitigate risks, and improve financial transactions' speed, accuracy, and security, addressing some of the most pressing challenges in the financial industry today [6].

B. Synergies between AI and blockchain in finance

The financial industry has a lot of opportunities for innovation and disruption due to the synergies between blockchain and AI. One important area of convergence is the use of AI to analyze blockchain data and extract useful information for financial applications. To provide proactive risk management and compliance monitoring, artificial intelligence (AI) systems can analyze blockchain transaction data to spot patterns pointing to fraudulent conduct or instructive market trends [6]. This is enhanced by blockchain technology, which offers a tamper-proof record that improves the audibility and transparency of AI choices [6].

Additionally, the development of smart contracts and decentralized autonomous organizations is made possible by coupling AI with blockchain. Based on predetermined guidelines and backup plans, these organizations automate financial operations. Smart contracts encoded with blockchain technology can provide decentralized exchanges, crowdsourcing, and peer-to-peer lending, removing the need for intermediaries and cutting down on transaction fees. Furthermore, by evaluating market data, projecting outcomes, and dynamically adjusting in real time to shifting circumstances, AI algorithms enhance the execution of smart contracts [6].

In conclusion, combining blockchain technology with artificial intelligence (AI) in banking can completely alter established financial institutions by increasing transparency, building trust, and boosting efficiency. Additionally, this shift may make new business models and inclusive financial opportunities possible. However, to guarantee the ethical and responsible incorporation of these powerful technologies into the financial environment, the technological, regulatory, and ethical barriers must be addressed [6].

IV. METHODOLOGY

A. Research Design and Approach

The current study adopts a research strategy that thoroughly examines and integrates existing literature on the convergence of artificial intelligence and blockchain technologies within the banking sector. The strategy merges qualitative and quantitative methods to deliver a holistic understanding of the integration's advantages and limitations of blockchain technology and AI in banking. The qualitative dimensions explore conceptual foundations, theoretical frameworks, and models relevant to the integration of blockchain and AI in finance through an extensive review of books, academic articles, industry reports, and regulatory documents to unearth key themes, trends, and theoretical perspectives driving the discourse on AI and blockchain integration [7].

Quantitative methodologies complement this by assessing empirical data illustrating the practical applications and outcomes of AI and blockchain integration in finance. This involves the statistical analysis of quantitative data such as financial performance metrics, transaction volumes, and user adoption rates to determine the impact of AI and blockchain on financial outcomes and organizational efficiency [7].

B. Data collection and analysis method

To collate data for this study, scholarly databases such as PubMed, Scopus, Web of Science, and Google Scholar will be systematically searched. The search will employ relevant keywords, including "artificial intelligence," "blockchain," "finance," "integration," and "synergy."

The data is subjected to qualitative content analysis to identify recurring themes, trends, and linkages in the literature. This process includes coding and categorizing data to draw significant insights, propositions, and recommendations regarding deploying AI and blockchain technology in banking. Quantitative data, such as user adoption rates and financial performance indicators, are analyzed using descriptive and inferential statistics to gauge the influence of AI and blockchain technologies on financial outcomes and organizational performance [5].



V. INTEGRATION OF AI AND BLOCKCHAIN IN FINANCE SECTOR

A. Risk Management and Fraud Detection

Incorporating blockchain technology and artificial intelligence into banking processes has significantly bolstered risk management and fraud detection capabilities. AI-powered algorithms, capable of analyzing large volumes of transactional data in real time, can identify unusual patterns indicative of fraudulent activity [8]. With their adaptive nature, machine learning models continuously refine fraud detection systems by learning from new data inputs [5]. AI algorithms also appraise risk factors associated with insurance claims, loan applications, and investment portfolios, facilitating proactive risk mitigation and enhancing decision-making [5].

Blockchain technology augments AI in risk management and fraud detection by providing a transparent and secure framework for recording and verifying transactions. Leveraging the decentralized ledger technology of blockchain, financial institutions can diminish the risks of data tampering, which bolsters the auditability and integrity of transaction records [5]. Moreover, smart contracts on the blockchain can autonomously enforce predetermined rules and conditions and carry out compliance checks, streamlining fraud detection and risk management processes [5].

B. Smart contracts and automation

Encoded on the blockchain, smart contracts are programmable, self-executing contracts that have emerged as powerful tools for automating financial transactions and streamlining business operations. AI algorithms can enhance the execution of smart contracts by analyzing market data, predicting transaction outcomes, and updating contract parameters dynamically in real-time. For example, AI-driven predictive analytics can assist in decision-making processes related to supply chain financing, processing insurance claims, and approving loans, enabling automated and efficient financial transactions [6].

Blockchain technology ensures the integrity and transparency of smart contract execution by providing an immutable record of contract terms, conditions, and outcomes [9]. Smart contracts can automate financial processes like asset transfers, payment settlements, and regulatory compliance, potentially removing the need for intermediaries and reducing the chances of errors or disputes [10]. Additionally, smart contracts can support the growth of decentralized autonomous organizations, paving the way for transparent financial ecosystems governed by predefined rules and consensus mechanisms.

C. KYC (Know Your Customer) and AML (Anti-Money Laundering) Compliance

In the financial sector, the synergy of blockchain and AI technologies is playing a transformative role in refining KYC and AML procedures. Artificial intelligence algorithms can effectively scrutinize transaction patterns and customer data to identify discrepancies and compliance issues, adapting swiftly to regulatory shifts and emergent threats. This advanced application of machine learning ensures that financial institutions can bolster the precision of their KYC and AML frameworks [9]. Blockchain's immutable record-keeping augments the security of customer data and transaction logs, streamlining transparency and accountability in compliance processes [9]. Leveraging blockchain for identity verification accelerates the KYC workflow and shortens customer onboarding times, elevating the overall user experience. Integrating real-time and immutable transaction monitoring via blockchain aids in detecting and reporting suspicious financial activity per regulatory norms [9].

The deployment of a decentralized, effective KYC procedure on a Quorum blockchain to enable media application provisioning. Since blockchains are potentially inappropriate for keeping personal data due to their transparency and irreversibility, it addresses the privacy problem in blockchain technology by suggesting an architecture that safeguards users' privacy [11].

Overall, the fusion of AI and blockchain within financial operations is poised to overhaul risk management, fraud detection, and regulatory adherence. These advancements promise a financial landscape characterized by automation, efficiency, and resilience, vigorously mitigating risks and enhancing the integrity of the financial ecosystem [9].

VI. CHALLENGES AND LIMITATIONS

A. Scalability Issues

Scalability is one of the main issues in integrating blockchain and artificial intelligence (AI) in financial processes. Large volumes of data and transactions must be processed by blockchain and AI systems, which can impose a strain on computing power and network capacity. Scalability becomes a crucial bottleneck as the amount of data and transactions processed on blockchain networks increases, affecting latency, cost-effectiveness, and transaction throughput.



To solve scalability problems and improve the efficiency and capacity of blockchain networks, creative approaches like sharding, off-chain processing, and layer two scaling are needed. Furthermore, distributed computing, cloud computing, and hardware acceleration developments can enhance the scalability of AI systems and algorithms. This allows for the processing of massive datasets and difficult computations in real-time.

B. Privacy and Security Considerations

Concerns about security and privacy are significant barriers to the widespread adoption of AI and blockchain technologies in financial operations. Blockchain's transparent and immutable ledger design offers inherent security features, such as encryption and cryptographic hashing, but also introduces new privacy challenges. The pseudonymity of blockchain transactions can complicate privacy and confidentiality, particularly in sensitive financial transactions where anonymity might be critical [12].

Furthermore, AI algorithms require access to large datasets for training and development, leading to questions about the security and privacy of the data involved. Unauthorized access to confidential financial data or manipulation of AI algorithms could result in fraud, identity theft, and privacy violations. There are also concerns about a lack of accountability and transparency in AI-driven decision-making processes, which can give rise to ethical issues such as algorithmic bias, discrimination, and unanticipated consequences [13].

Addressing these privacy and security issues necessitates the deployment of strong encryption protocols, access controls, and data anonymization techniques that protect sensitive data and ensure regulatory compliance. To enhance trust and accountability in AI-driven financial processes, measures such as explainable AI and regular algorithmic auditing could be employed [13].

C. Regulatory Concerns

Financial institutions are dealing with a rapidly evolving regulatory environment characterized by complex and scattered regulations across jurisdictions, which introduces uncertainty and complicates compliance efforts. As the article suggests, there is a potential for information to be manipulated within the existing regulatory framework, which raises issues related to consumer protection, financial transparency, data privacy, and anti-money laundering [10]. As the convergence of AI and blockchain technologies emerges, new regulatory dilemmas surrounding algorithmic transparency, accountability, and governance arise. Regulators face a delicate balance between fostering innovation and ensuring consumer protection as they effectively attempt to oversee blockchain-based applications and AI-driven financial services. The article points out that the regulatory and reporting frameworks in India may not be adequate to address information asymmetry, adverse selection, and moral hazard typically found in corporate banking, suggesting a need for improved oversight [10].

To navigate these regulatory barriers, industry players, lawmakers, and regulators must collaborate on developing adaptable and technology-neutral frameworks. This joint effort would encourage innovation while safeguarding consumer interests and the stability of financial systems. Engaging in pilot projects, forging industry alliances, and implementing regulatory sandboxes could facilitate a more nuanced understanding of the benefits and challenges of integrating blockchain and AI into financial operations, as implied by the discussions around technology use in banking and associated risk management in the article [14].

VII. FUTURE SCOPE AND RESEARCH

A. Emerging Trends in AI and Blockchain Integration:

1. **Scalability Solutions:** Advancements in sharding techniques, off-chain processing, and layer two scaling solutions could address scalability limitations in blockchain networks. Research and development efforts focused on improving transaction throughput, reducing latency, and lowering transaction costs could drive AI and blockchain integration innovation. The study by [15] reinforces the potential for blockchain technology to significantly reduce operating costs in back-end operations of investment banks through cryptographic distributed ledgers for transaction execution, suggesting that scalability solutions could further amplify these cost-saving benefits.

2. **Privacy-Preserving AI:** The development of privacy-preserving AI techniques, such as federated learning, homomorphic encryption, and differential privacy, could enhance data privacy and confidentiality in AI-driven financial operations. These techniques enable collaborative learning and analysis of sensitive data across decentralized networks without compromising individual privacy. Incorporating insights from the study by [15], which highlights the role of blockchain technology in improving transparency and security, could inform the development of privacy-preserving AI solutions that leverage blockchain's cryptographic features to enhance data privacy in financial transactions.



B. Potential Applications in Other Financial Subsectors:

1. **Insurance:** Overcoming scalability and privacy limitations could enable new applications of AI and blockchain integration in insurance, such as parametric insurance, usage-based insurance, and peer-to-peer insurance. These applications leverage AI-powered risk assessment models and blockchain-based smart contracts to automate insurance processes and enhance customer experiences. The findings from the [15] study, which highlight the potential for AI and blockchain integration to detect fraud, manage customer support, and digitize processes, suggest that similar applications could be extended to the insurance sector to improve efficiency and customer satisfaction.

2. **Supply Chain Finance:** Addressing scalability and interoperability challenges could unlock new opportunities for AI and blockchain integration in supply chain finance, enabling real-time tracking, transparency, and optimization of supply chain processes. AI algorithms could analyze supply chain data to identify inefficiencies, predict demand trends, and optimize working capital management, while blockchain technology ensures transparency and trust in financial transactions. The study by [15] underscores the role of blockchain technology in improving transparency and efficiency in financial operations, suggesting that similar benefits could be realized in supply chain finance through AI and blockchain integration.

C. Recommendations for Industry and Policy Makers:

1. **Invest in Research and Development:** Allocate resources for research and development initiatives focused on addressing operational limitations and driving innovation in AI and blockchain integration. To accelerate technological advancements and foster collaboration between industry stakeholders, academic institutions, and research organizations. The study by [15] provides empirical evidence supporting the benefits of AI and blockchain integration in banking operations, reinforcing the importance of investing in research and development initiatives to capitalize on these transformative technologies.

2. **Enhance Cybersecurity Measures:** Implement robust cybersecurity measures to protect AI and blockchain systems from potential threats and vulnerabilities. Invest in cybersecurity training, risk assessment, and incident response capabilities to safeguard financial operations and data integrity. Incorporating insights from [15] study, which highlights the role of blockchain technology in improving security and efficiency in financial operations, could inform the development of cybersecurity measures tailored to AI and blockchain integration in the finance sector.

Collaborate with Regulatory Bodies: Engage with regulatory bodies and policymakers to address compliance challenges and ensure alignment with existing regulatory frameworks. Advocate for clear, flexible regulations promoting innovation while safeguarding consumer interests and systemic stability. The study by [15] explores the challenges and opportunities in implementing AI and blockchain technologies in banking, emphasizing the importance of collaboration with regulatory bodies to address compliance challenges and ensure responsible adoption of these technologies.

VIII. CONCLUSION

Summary of key findings:

This study explores AI's and blockchain integration's transformative potential and challenges in finance. Key findings reveal how AI algorithms empower risk management, fraud detection, and decision-making, while blockchain fosters transparency, security, and efficiency through its decentralized ledger system.

However, scalability, privacy, security, and regulatory concerns require scalable architectures, privacy-preserving AI techniques, robust cybersecurity, and collaborative regulatory frameworks.

To unlock the full potential, we recommend:

- * R&D investments: Drive innovation and address limitations through focused research.
- * Enhanced cybersecurity: Implement robust measures to safeguard systems and data.
- * Collaboration with regulators: Work with policymakers to develop adaptable frameworks that foster innovation while protecting consumers and the financial system.
- * Industry-wide collaboration: Share best practices and tackle common challenges collaboratively.

By embracing these recommendations, the finance sector can navigate the complexities of AI and blockchain integration, ushering in a new era of transparency, efficiency, and trust for all.

**Implications for the financial management:**

Combining AI and blockchain will significantly impact the finance sector, changing conventional business models, procedures, and legal frameworks. While individuals may have better access to cutting-edge financial services and products, financial institutions stand to gain from increased efficiency, transparency, and trust in financial processes. But to fully enjoy these advantages, scalability, privacy, security, and regulatory compliance issues must be carefully considered.

Financial institutions must spend on R&D projects, hiring personnel, and technical infrastructure to exploit AI and blockchain integration's potential. Furthermore, to promote innovation and guarantee the responsible and long-term adoption of blockchain and artificial intelligence (AI) in the financial sector, industry cooperation, regulatory clarity, and consumer education are crucial.

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