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# THE ROLE OF FINTECH IN TRANSFORMING RISK MANAGEMENT AND FINANCIAL SERVICES: A SYSTEMATIC REVIEW AND META-ANALYSIS

## ABSTRACT

Integrating artificial intelligence and blockchain in financial services has transformed risk management, enabling advanced fraud detection, compliance, and predictive analytics. However, there is a significant gap in the literature regarding a meta-analytic comparison of these technologies' effectiveness within the sector. The study aims to bridge the gap by conducting a meta-analysis, assessing the impact of AI and blockchain on various aspects of financial risk management. The study includes a meta-analysis approach, systematically synthesizing findings from recent studies on blockchain and AI in financial risk management. Following strict inclusion criteria, a comprehensive search through Scopus and Google Scholar led to the selection of 36 studies for analysis. The forest plots and summary tables were generated using Meta-Essentials, a statistical tool for meta-analyses that calculates effect sizes, confidence intervals, and pooled estimates using fixed and random effects models for accurate interpretation. The meta-analysis revealed that blockchain technology enhances financial security and transparency, particularly post-COVID, addressing operational risks with a modest but non-significant effect (HR = 1.04, 95% CI: 0.99-1.10, p = 0.11). AI demonstrated a neutral impact on risk management (HR = 0.99, 95% CI: 0.94-1.04, p = 0.71) but excelled in fraud detection and predictive analytics. Funnel plot analysis showed minimal publication bias, and forest plots confirmed consistent findings across studies. These results showed that Blockchain enhances transparency and security post-COVID, mitigating financial digital threats, while AI excels in fraud detection and predictive analytics. AI revolutionizes risk management through predictive insights, while blockchain ensures data integrity. Future research should refine sector-specific applications for both technologies.

**Keywords:** FinTech, artificial intelligence, blockchain, framework, challenges, financial services, risk management

**JEL Classification:** G32, G17, O33, D81, E42

## INTRODUCTION

FinTech, a term coined by FinTech Futures, refers to emerging technological advancements in the financial sector, such as credit card services, online banking, and digital currencies. These advancements enable consumers, investors, and businesses to stay updated, expand market share, and offer services with minimal to no fees. The financial crisis of 2008 led to rapid investment in FinTech, affecting the United States, European, and Asian markets (Ng & Kwok, 2017; Skan et al., 2015). As a result, the evolution of FinTech has introduced technological advancements into an industry engulfed in compliance and regulatory oversight. Fintech refers to companies that combine financial services with modern, innovative technologies, aiming to provide more effective and less costly financial services (AlMomani & Alomari, 2021). In the financial sector, start-up companies attempt to acquire market shares at the expense of traditional players. Thus, the growing role of FinTech in the financial sector is crucial for anticipating future changes and distilling public policy priorities.

### ***Needs for Risk Management***

The ultimate goals of economic intelligence, primarily based on information technology, include management as a whole and managing information in a knowledge and information-intensive economy. Over time, economic intelligence has evolved through four stages: economic information, vigilance, organization of networks, and everyday culture and practice. Also, the evolution has strengthened the link between economic intelligence and risk management, becoming essential for mitigating informational risks within financial institutions (Peng et al., 2021). Technological change in the financial industry has accelerated, with the COVID-19 crisis presenting challenges to financial institutions, including the Great Financial Crisis, regulatory reform, low profitability, and deteriorating public trust (Boot et al., 2021).

### ***Role of AI and Blockchain in Financial Risk Management***

Risk management in the financial sector is becoming increasingly complex due to the rapid integration of Fintech innovations like big data analytics, artificial intelligence (AI), and blockchain technology (Yalamati, 2022). These technologies offer new opportunities for enhancing financial services, such as improving fraud detection, credit scoring, and market risk assessment. However, they also introduce risks related to cybersecurity, compliance, and systemic vulnerabilities (Callen-Naviglia & James, 2018). Regulatory bodies are now focusing on creating a unified risk management framework that addresses these challenges without stifling innovation. A balanced approach involving both RegTech (regulatory technology) and SupTech (supervisory technology) is essential to facilitate effective risk management while maintaining financial stability (Batista & Ringe, 2020).

The primary objective of meta-analysis is to evaluate the efficacy of recent innovations in FinTech, specifically blockchain technology and AI, as these technologies enhanced risk management in financial services. By performing a comprehensive meta-analysis, the study aims to evaluate the impact of these technologies in improving fraud detection, predictive analytics, and regulatory compliance, as well as the challenges and limitations faced by adopting these technologies.

The study comprises five sections that analyze the recent trends of AI and blockchain in the financial sector. The first section, "literature review," evaluated recent trends and innovations and the challenges the previously published studies highlighted. The second section comprises methodology that includes the criteria of study selection for comprehensive meta-analysis, while the third results and discussion section will comprise the findings obtained from the analysis of the included studies. The fourth section includes limitations and future directions of this analysis, followed by a conclusion, as the last section highlights the findings' comprehensive summary.

## **LITERATURE REVIEW**

### ***Blockchain Technology in Financial Risk Management***

Blockchain, initially popularized by cryptocurrencies like Bitcoin in 2017, is now recognized for its broad potential across various industries, especially in banking and financial services (Javaid et al., 2022). With cryptography, peer-to-peer networking, and game theory, blockchain functions as a decentralized ledger, ensuring transaction trustworthiness and anonymity (Chang et al., 2020). This technology introduced a decade after the 2008 financial crisis, is increasingly used in various business sectors, including finance, accounting, and auditing. Blockchain records all transactions, making it almost impossible to be hacked. For instance, central banks in India are exploring blockchain for its potential, though concerns remain about its cost-effectiveness and disruptive impact on existing business models (Laroiya et al., 2020).

### ***Critical Applications in Financial Risk Management***

For the understanding that blockchain offers specific financial risks, several high-impact applications particularly relevant to financial risk management have been discussed below.

#### ***Digital Identity for KYC/AML***

In financial institutions, Know Your Customer (KYC) and Anti-Money Laundering (AML) procedures are critical for verifying identities and preventing illicit activities. Blockchain's use in digital identity verification reduces fraud and identity theft risks by providing a secure, immutable record of identity information. Solutions like Civic and uPort streamline the KYC process, making it faster and more secure, significantly lowering compliance costs and risks of non-compliance (Mondal et al., 2016).

### **Anti-Money Laundering (AML) Tracking**

The transparency of the blockchain enables enhanced monitoring of transactions, which is crucial for tracking money laundering activities. AML platforms like Elliptic and Chainalysis utilize blockchain to improve the accuracy of detecting suspicious transactions and reduce regulatory risks. This factor is most important for financial institutions facing compliance requirements, as blockchain reduces costs related to AML oversight while enhancing security (Ogbeide et al., 2023).

### **Smart Contracts**

Automated smart contract instances on the Ethereum platform have been instrumental in financial risk management due to eliminating operational risk. Such smart contracts reduce the need for third parties, thus eliminating instances of disagreement and related expenses. Precision is achieved through automation, and since blockchain cannot be altered, it increases the credibility of the financial arrangements (Ivanov et al., 2023).

### **Cross-border Payments**

Traditionally, cross-border payments involve significant risks due to exchange rate fluctuations, regulatory complexities, and transaction delays. Through solutions like Ripple (XRP), blockchain offers faster, more secure, and cost-efficient cross-border payment mechanisms, mitigating currency and transaction risks. This transparency and efficiency enhance trust among stakeholders and reduce the potential for errors (Habeb, 2020; Villaluenga).

### **Supply Chain Finance**

In supply chain finance, blockchain strengthens risk management by offering transparent transaction tracking, critical during economic uncertainties. IBM Blockchain's solutions provide detailed risk assessments, protect financial privacy, and support resilient supply chain operations. This transparency lowers the risk of fraud, enhances trust, and reduces financing costs, essential for mitigating financial risks in supply chains (Dutta et al., 2020).

### **Impact of Blockchain in Financial Risk Management**

Blockchain technology offers several key benefits in financial risk management. In the accounting industry, blockchain helps companies write their transactions into joint bookkeeping, creating an interlocking system of enduring records. Cryptocurrencies, virtual digital currencies, have become increasingly important in the financial services market over the last decade (Mosteanu & Faccia, 2020). It significantly reduces firm default risk by increasing trust, optimizing processes, and enhancing information disclosure (Sun et al., 2023). According to Ali et al. (2021) and Meng (2022), robust security mechanisms, such as differential privacy and advanced algorithms, provide enhanced protection and privacy for financial transactions (Ali et al., 2021; Meng, 2022). By eliminating intermediaries, blockchain mitigates risks related to hacking, privacy breaches, and regulatory compliance costs.

Additionally, in the banking sector, when combined with artificial intelligence, blockchain automates risk management processes, improves credit scoring, and enhances market risk assessments. According to Meng (2022), blockchain technology in supply chain finance helps protect financial privacy and provides detailed risk assessment, making it beneficial for risk control and efficient financial management (Meng, 2022). It also strengthens supply chain resilience by providing transparent transaction tracking, which is vital during periods of uncertainty. Moreover, blockchain reduces corporate financing costs and improves efficiency by streamlining operations and fostering stakeholder trust (Sun et al., 2021).

The real-world applications of blockchain technology extracted from the literature of previously published studies are summarised in Table 16.

No	Application	Sector	Key Advantages	Examples
1	Digital Identity	KYC/AML	Secure verification, faster compliance	Civic, uPort
2	Anti-money Laundering (AML)	Compliance	Enhances security, improves transaction monitoring	Elliptic, Chainalysis
3	Smart Contracts	Contracts	Automates processes, reduces third-party risks	Ethereum
4	Cross-border Payments	Payments	Faster, cheaper, and secure transactions	Ripple (XRP)
5	Supply Chain Finance	Supply Chain	Transparent transaction tracking, risk assessment	IBM Blockchain

### Artificial Intelligence in Financial Risk Management

AI technology, including machine learning (ML), neural networks, and natural language processing (NLP), solves financial risk management problems. AI mechanisms such as these are programmed to look for patterns in large databases, thus allowing financial institutions to address risks in real-time. Research indicates that prediction models that are provided by AI enhance risk assessment accuracy by evaluating both structured and unstructured data (Russell & Norvig, 2016). For instance, neural networks can analyze complex data to forecast market trends, a vital element of risk management that can only be achieved using AI. Liu et al. (2024) have noted that AI in banking usually automates repetitive tasks like credit scoring and fraud detection and does away with human errors as Ghassemi et al. (2021) recorded (Ghassemi et al., 2021; Liu et al., 2024).

Today, AI solutions are actively integrated into financial services, primarily for fraud prevention, investment management, and risk compliance. Real-time data analyses in transactional datasets can be conducted using AI algorithms in fraud detection, with more accuracy than other traditional methods, enhancing security (Bussmann et al., 2021). In addition, AI is commonly applied in credit risk management when evaluating traditional credit and non-credit information, such as social networks and customers' behaviour, which resulted in more detailed credit evaluation (Huang et al., 2020). The role of AI in regulatory technology (RegTech) includes intelligent compliance checks that enhance operational performance and concurrently decrease costs for financial institutions concerning compliance with the regulations governing the financial industry (Arner et al., 2016).

Besides risk assessment and compliance, AI also involves the management of wealth customer service within financial institutions. AI-based robo-advisors provide customers with tailored investment advice depending on market conditions, client ratings, and risk levels (Sironi, 2016). These robo-advisors make wealth management available and affordable to more people than human financial advisors do at a cheaper cost. Moreover, conversational commerce has been prominent, where chatbots based on AI are turning customer service inquiries and solving issues in real-time, contributing to customer satisfaction and engagement (Kraus et al., 2022). This is primarily an added advantage in that it further enhances the efficiency of operations because it minimizes the use of human resources in carrying out simple services.

Implementing AI systems in financial services has provided a transformative improvement in risk and operational effectiveness and the ability to influence the overall improvement of customer experience for the future. A few real-world applications of AI technology extracted from the literature of previously published studies are summarised in Table 17.

**Table 17. AI Applications in Financial Services Across Various Sectors with Key Advantages and Examples.**

No	Application	Sector	Advantages	Examples
1	Fraud Detection	Banking and Payments	Identifies and prevents fraudulent activities effectively	PayPal, Mastercard
2	Credit Scoring	Lending	Provides a comprehensive view of borrowers' credit-worthiness	Upstart, Zest AI
3	Algorithmic Trading	Investment Management	Executes trades at high speed based on market analysis	Renaissance Technologies, Citadel Securities
4	Personalized Financial Advice	Wealth Management	Offers tailored investment strategies to clients	Betterment, Wealthfront
5	Risk Assessment	Investment Banking	Enhances predictive accuracy for potential risks	Kabbage, Credit Karma
6	Regulatory Compliance	Regulatory Technology (RegTech)	Reduces compliance costs and ensures regulatory adherence	Ayasdi, ComplyAdvantage
7	Chatbots for Customer Service	Retail Banking	Improves customer engagement through instant responses	Bank of America, Capital One
8	Insurance Underwriting	Insurance	Accurately assesses risk for determining premiums	Lemonade, Progressive
9	Portfolio Management	Asset Management	Optimizes investment portfolios through data analysis	BlackRock, Charles Schwab
10	Market Sentiment Analysis	Trading	Gauges market sentiment for better trading decisions	Bloomberg Terminal, MarketPsych
11	Payment Processing	E-commerce	Increases security and efficiency in payment systems	Stripe, Square
12	Wealth Management Automation	Wealth Management	Streamlines portfolio rebalancing and recommendations	Personal Capital, Vanguard
13	Customer Risk Profiling	Banking	Identifies high-risk clients for targeted strategies	FICO, Experian
14	Tax Compliance	Accounting	Minimizes errors and automates tax reporting	Intuit, H&R Block
15	Financial Forecasting	Financial Planning	Predicts future financial performance with accuracy	SAP Analytics Cloud, IBM Planning Analytics

## AIMS AND OBJECTIVES

The study aims to bridge the gap through a meta-analysis assessing the impact of artificial intelligence and blockchain on various aspects of financial risk management.

## METHODS

### *Research Design*

This study employs a meta-analysis research design, a quantitative, systematic approach used to synthesize and evaluate findings from multiple studies. Meta-analysis is particularly useful for identifying trends, comparative insights, and assessing the overall effectiveness of the research topic. For instance, this study employed this method to identify the overall trends of fintech technologies, specifically blockchain and artificial intelligence (AI), in risk management across financial services. By integrating data from existing studies, this design allows for an empirical and comprehensive understanding of the research domain that any individual study could provide.

This design was adopted by following a structured process. First, a systematic literature search was done using Scopus and Google Scholar to identify relevant studies. The selected studies were then screened based on the specific inclusion and exclusion criteria to ensure that only the most relevant and high-quality research was included. Once the studies were identified, data extraction focused on critical variables such as study design, technology (blockchain or AI), and critical financial service risk management findings. The extracted data were then systematically analyzed to identify common trends, challenges, and the efficacy of each technology. The steps of the methodology are comprehensively summarised below.

This approach to research design was taken by the methodologies used in previously published meta-analyses by several authors. These authors have highlighted the importance of meta-analysis in identifying technological trends and impacts within financial and technological sectors (Bergmann et al., 2023; De Bakker et al., 2010; Kutowaroo et al., 2023; Mishra et al., 2024). The studies suggested that combining larger datasets from various studies can improve clarity and understanding of complex subjects like fintech applications in risk management.

### *Search for Relevance*

A comprehensive search strategy was conducted using Scopus and Google Scholar to ensure the most relevant and up-to-date research was included. The search focused on studies published between 2019 and 2024, comprised of the most recent advancements in blockchain and AI technologies in the context of risk management within financial services. Database searches of blockchain for risk management in financial services were conducted using the keyword search "blockchain operational risk", "blockchain compliance in finance", "blockchain efficacy in financial services", "blockchain applications in financial risk management" and "blockchain challenges in financial services", while for the search of AI-based studies, the keywords and phrases search were "AI risk management in finance", "AI financial risk prediction", "AI adoption in financial risk management", "AI applications in financial services" and "AI limitations in financial services".

### *Criteria for Inclusion and Exclusion of Studies*

The specific inclusion/exclusion criteria maintained the relevancy and integrity of the study for conducting meta-analysis. Studies published between 2019 and 2024 focusing on adopting AI and blockchain technology in financial services for different sectors and providing empirical evidence of the efficacy of these technologies were included. Additionally, peer-reviewed journal articles, conference papers, and literature reviews were included due to their substantial contributions to understanding fintech's role in mitigating financial risks.

However, studies that did not meet the time frame of the literature search (published before 2019), either they were relevant or focused on the efficacy of targeted technologies, were excluded. Additionally, theoretical papers without any empirical evidence and those concentrating only on technical aspects of blockchain or AI without exploring their risk management applications were excluded. This approach ensured that only the most relevant, high-quality, and appropriate studies were used in the meta-analysis.

### *Data Collection Process*

The data extraction process for this meta-analysis was meticulously designed to capture crucial information from the selected studies, ultimately evaluating the role of blockchain and artificial intelligence (AI) in financial risk management. A

total of 36 studies were included after a thorough screening process, and a PRISMA flow diagram (**Ошибка! Источник ссылки не найден.**) was created to represent the selection process visually. Initially, the studies were analyzed using literature review, case reports, etc. Another critical step of the extraction process was identifying the technological focus of each study, categorizing them based on whether they examined blockchain or AI. This allowed for a clear difference between the two risk management financial services analysis technologies.

The studies were analyzed using blockchain and AI in financial risk management, focusing on their efficacy in addressing operational, compliance, financial, credit, or market risks. Quantitative evidence and comparisons were extracted, providing a practical view of these technologies. However, the studies that identified disadvantages, such as technical issues, regulatory policies, and technique limitations, were also analyzed. This structured extraction ensured a comprehensive comparison analysis of blockchain and AI in financial risk management, highlighting trending research and challenges in financial services.

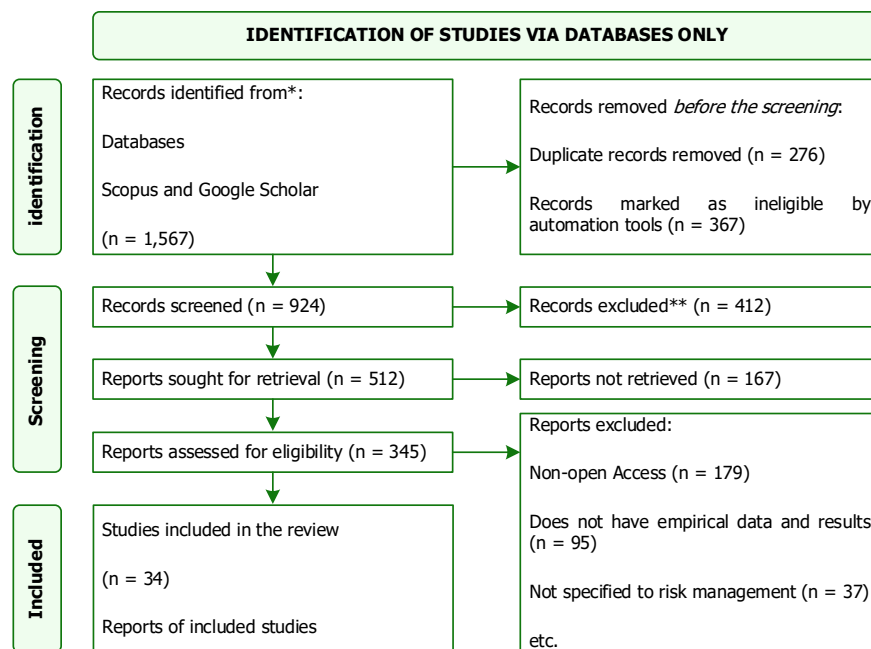


Figure 2. PRISMA Flow Diagram.

### Meta-analysis by plots

The forest plots and summary tables were generated using Meta-Essentials, a user-friendly statistical tool designed for conducting meta-analyses. Meta-Essentials offers comprehensive functionalities for calculating effect sizes, confidence intervals (CI), and pooled estimates using both fixed and random effects models, ensuring accurate and transparent interpretation of meta-analytic data. The forest plots were created for two groups of studies: AI-based and Blockchain-based, each with 17 studies. These plots visually represent each study's effect size and confidence interval, with individual points and error bars indicating the precision of the results. A central reference line at "one" highlights the position of effect sizes relative to no effect, while combined effect sizes, calculated through both fixed and random models, are marked at the bottom of each plot to summarize the overall impact of each technology on risk management (Andrade, 2020). Additionally, funnel plots were created to assess publication bias, ensuring the reliability and completeness of the analyzed literature.

### Results Synthesis

The results of the included studies were analyzed using Excel to create visuals and statistical graphical representations of the manually extracted data. Summary tables comprise specific information from the 36 included studies that analyzed the efficacy of AI and blockchain in financial services. The analysis also comprises various diagrams, such as bar graphs and pie charts, highlighting trends for the efficacy of these technologies, including their challenges and limitations. These results are considered an essential aspect of analyzing the trends of AI and blockchain technology trends in financial sectors.

## RESULTS AND DISCUSSION

### Analysis of Blockchain Technology

The analysis of included studies based on blockchain technology has been summarised in Table 18.

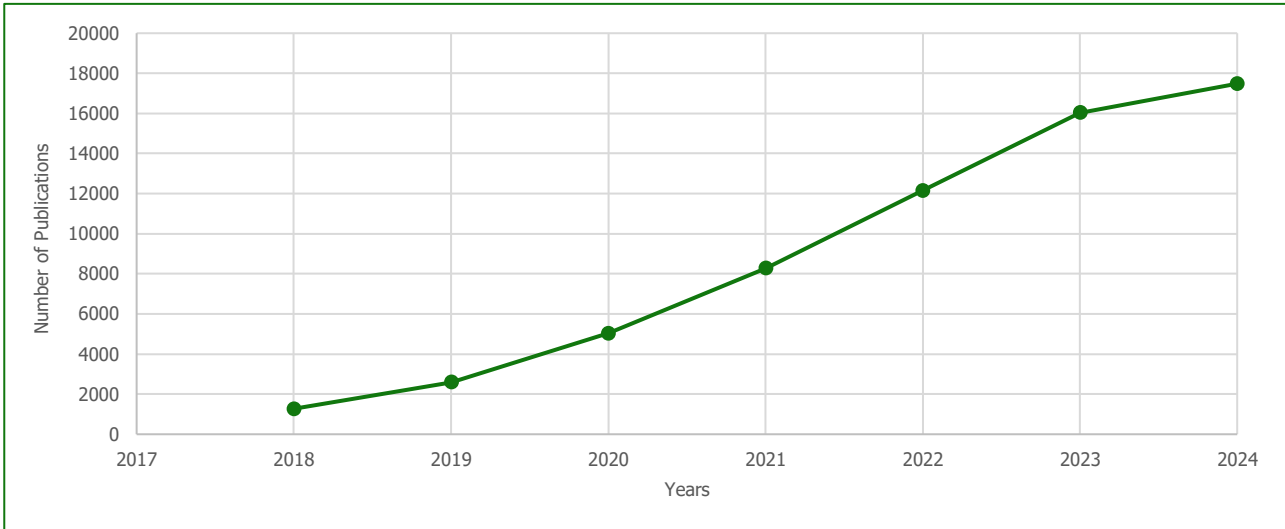
**Table 18. Summary of Blockchain Technology Applications in Financial Sectors with Key Themes, Challenges, and Benefits.**

No	Studies	Financial Sector	Key Themes	Challenges Noted	Benefits Identified
1	(Collomb et al., 2019)	Fundraising (IPOs, ICOs)	Regulation, Risk Equivalence, Compliance	Regulatory Ambiguity, Compliance Challenges	Increased Regulatory Compliance, Transparency
2	(Chang et al., 2020)	General Financial Sector	FinTech Impact, Knowledge Sharing, Blockchain Adoption	Knowledge Hiding, Blockchain Adoption Barriers	Efficient Financial Operations, Enhanced Trust
3	(Varma, 2019)	General Financial Sector	Decentralization, Trust, Cryptocurrency Impact	Trust Issues in Centralization, System Reliability	Reduction in Trust Dependency, Enhanced Security
4	(Chowdhury et al., 2023)	Supply Chain Management	Transparency, Risk Management, OSCM Adoption	VUCA Environment, OSCM Adoption	Improved Risk Management, Transparency
5	(Atova & Tayachi, 2019)	Islamic Finance	Shari'ah Compliance, Smart Contracts, Credit Risk Reduction	Operational Risks, Smart Contract Acceptance	Cost Reduction, Enhanced Shari'ah Compliance
6	(Polyviou et al., 2019)	General Financial Sector	Decentralization, Financial Transformation, Trust	Decentralization Risks, Trust Issues	Improved Security, Lower Costs
7	(Grima et al., 2021)	General Financial Sector	Blockchain Use Cases, Financial Revolution	Blockchain Adoption in Traditional Finance	Enhanced Efficiency, Security Improvement
8	(Scott et al., 2024)	Insurance	Digital Risk Resilience, Compliance, EU Regulations	Timeliness, Integration Challenges	Compliance with EU Standards, Operational Resilience
9	(Li et al., 2024)	Credit Risk Management	Credit Risk, Machine Learning, Fraud Reduction	Data Complexity, Machine Learning Limitations	Accurate Risk Predictions, Fraud Detection
10	(Li, 2024)	Financial Risk Management	Financial Early Warning, Predictive Accuracy	Risk Accuracy, Data Integrity	Accurate Risk Warning, Predictive Financial Security
11	(Deng et al., 2024)	General Financial Sector	Smart Contracts, Automation, Financial Security	Fraud Detection Complexity, Smart Contract Automation	Improved Contract Security, Automation Benefits
12	(Dozier & Montgomery, 2019)	Supply Chain Management	Risk Management, Supply Chain, COVID-19 Response	Adoption in Crises, Technological Adaptation	Improved Decision-Making, Supply Chain Transparency
13	(Dashottar & Srivastava, 2021)	Banking Sector	Credit Risk, Regulatory Framework, Information Asymmetry	Information Asymmetry, Regulatory Compliance	Enhanced Credit Risk Management, Data-Driven Decisions
14	(Mishra & Kaushik, 2023)	General Financial Sector	Peer-to-Peer, Security, Cost Reduction	System Complexity, Security Measures	Cost Efficiency, Enhanced Security
15	(Li, 2023)	Financial and Monetary Sector	Digital Finance, Security, Blockchain Evaluation	Data Security, Risk Management Accuracy	Improved Financial Stability, Blockchain Efficacy
16	(Odeyemi et al., 2024)	General Financial Sector	Security, AI Integration, Fraud Detection	Integration of AI, Blockchain Synergies	Enhanced Security, Regulatory Compliance
17	(Ahmad et al., 2023)	Financial Sector Security	Cryptography, Decentralization, Financial Transformation	Cryptography Challenges, Security Issues	Improved Transparency, Financial Security

Figure 3 highlights the number of publications on blockchain technology between 2018 and 2024, with a clear trend of increased growth since 2020. Although the study in the field of blockchain was increasing, the advent of COVID-19 accelerated the search for a decentralized and secure solution in the banking sector. The pandemic has highlighted weaknesses in conventional financial systems in risk management, transparency, and operational readiness. Blockchain, a solution, is being explored in the fintech industry to mitigate post-COVID financial risks. Research on fintech's effectiveness in risk management addresses these challenges, highlighting the need for improved operational readiness.

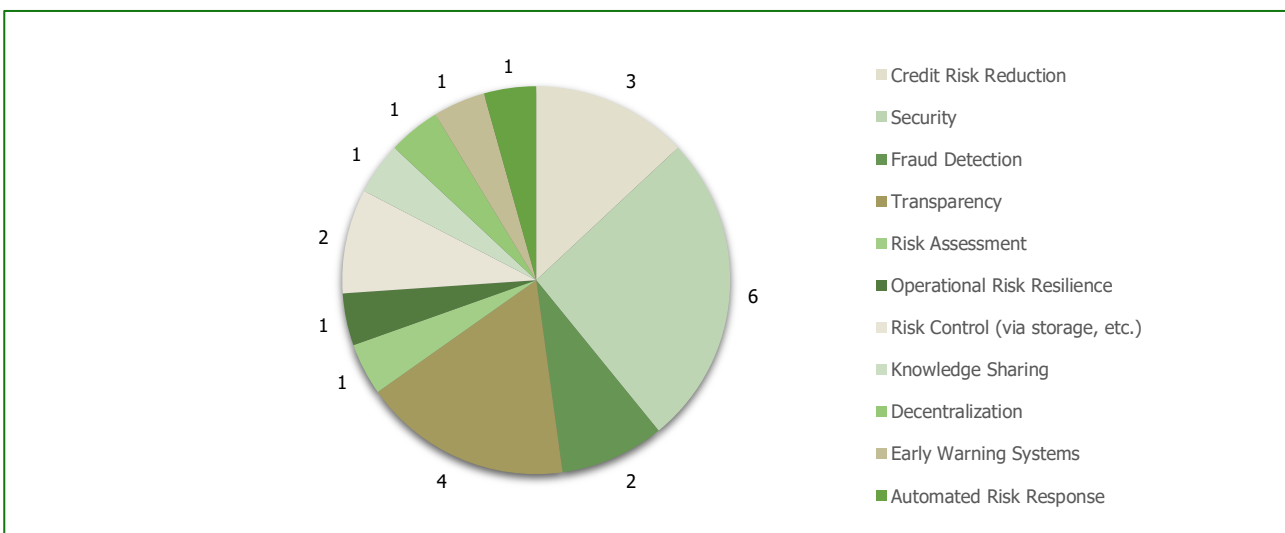
These results align with the previously published scholarly works included in the dataset. According to the analysis of these studies, Grima et al. (2021) highlighted that the COVID-19 pandemic significantly accelerated the adoption of blockchain technology, particularly in the financial sector and supply chain management (Grima et al., 2021). As financial services

faced a 38% rise in cyberattacks due to increased dependency on ICT during the pandemic, traditional systems struggled to address growing digital threats (Commission, 2020). Chowdhury et al. (2023) highlighted these exposed vulnerabilities and the need for more secure, transparent, and resilient systems. Blockchain technology emerged as a critical solution, enhancing processes' reliability, accuracy, and incorruptibility, making it an attractive tool for managing risks in uncertain, complex environments (Chowdhury et al., 2023). By providing greater transparency and accountability, blockchain has proven invaluable in strengthening risk management frameworks during crises like the pandemic.



**Figure 3. Growth of Publications in Blockchain Technology, 2018-2024.**

The pie chart in Figure 4 highlights the significant role of blockchain technology in security, with six studies focusing on enhancing security protocols. Transparency is explored in four studies, while fraud detection and credit risk reduction in operational risk mitigation receive moderate attention. Blockchain is also used to prevent fraudulent activities and strengthen financial stability. However, decentralization, knowledge sharing, and automated risk response are still in the development stages for their application in risk management.



**Figure 4. Distribution of Studies on Risk Management Aspects Addressed by Blockchain Technology.**

The analysis of included studies based on AI technology has been summarised in Table 19.

**Table 19. Summary of Blockchain Technology Applications in Financial Sectors with Key Themes, Challenges, and Benefits.**

No	Studies	Financial Sector	Key Themes	Challenges Noted	Benefits Identified
1	(Barile et al., 2024)	Banking	AI-driven Robo-Advisors, Personalization, Investment Automation	Lack of Human Interaction, Customer Trust	Cost Reduction, Personalized Advice
2	(Cao, 2022)	General Financial Sector	AI Techniques, Challenges, Opportunities in Finance	Data Complexity, Ethical Considerations	Improved Financial Operations, AI-Driven Insights
3	(Mhlanga, 2021)	Banking and Credit	Machine Learning for Credit Risk, Financial Inclusion	Data Availability, Information Asymmetry	Enhanced Credit Access, Risk Reduction
4	(Belanche et al., 2019)	FinTech	AI in Robo-Advisors, Adoption Factors	Technology Familiarity, Consumer Skepticism	Wider Consumer Reach, Adaptability
5	(Mohan et al., 2024)	General Financial Sector	Fraud Detection, AI Techniques, Risk Mitigation	AI Bias, Systemic Risk, Data Governance	Fraud Detection Efficiency, Accuracy
6	(Gayam, 2021)	General Financial Sector	AI Techniques in Fraud Detection, Anomaly Detection	High False Positives, Model Transparency	Real-Time Fraud Detection, Anomaly Insights
7	(Pattiyam, 2021)	Financial Markets	AI for Stock Prediction, Risk Management, Automated Trading	Data Volume, Market Volatility	Accurate Predictions, Automated Decisions
8	(Sabir et al., 2023)	FinTech	Robo-Advisors Adoption, Consumer Perception	Cultural Differences, Adoption Barriers	Consumer Trust, Service Customization
9	(Fatima & Chakraborty, 2024)	Investment (India)	Robo-Advisors, Consumer Trust, Performance Expectations	Human vs AI Preferences, Trust Issues	Risk Reduction, Improved Investment Strategies
10	(Nimmagadda, 2020)	Banking, Insurance, Investment	AI Risk Management, Data-Driven Decision Making	Data Integration, Model Accuracy	Proactive Risk Management, Better Decision Making
11	(Javaid, 2024c)	General Financial Sector	AI Predictive Analytics, Decision-Making, Risk Assessment	Data Volume, Accuracy in Predictions	Predictive Accuracy, Risk Mitigation
12	(Javaid, 2024b)	Insurance	AI and Blockchain Integration, Insurance Security	Data Security, AI Integration Complexity	Improved Security, Transparency
13	(Nimmagadda, 2021)	Financial Accounting and Management	AI in Financial Automation, Efficiency, RPA	Unstructured Data, Decision Complexity	Cost Efficiency, Enhanced Accuracy
14	(Zhan et al., 2024)	General Financial Sector	Fraud Detection, AI Algorithms, Machine Learning	Scalability, Real-Time Detection	Better Fraud Detection, Risk Insights
15	(Potla, 2023)	General Financial Sector	AI for Fraud Detection, Transaction Monitoring	System Complexity, Scalability	Real-Time Monitoring, Transaction Accuracy
16	(Zand, 2020)	Anti-Money Laundering	AI in AML, Risk Mitigation, Data Analysis	AI Trust, Explainability, Compliance	Enhanced AML Systems, Fraud Prevention
17	(Javaid et al., 2022)	General Financial Sector	Blockchain for Financial Services, Security, Risk Management	Data Security, Blockchain Integration	Improved Security, Risk Management

The graph in Figure 1, derived from the Dimensions with the application of the technology domain and years of analysis filter, highlighted the growing interest in AI in financial risk management by the increasing number of published papers. Since 2018, the popularity and academic attention have grown, with the number of publications tripled by 2024. AI is a critical technology enhancement method that helps the banking industry manage large volumes of data in real-time for risk assessment. It can identify market, fraud, and credit risks, change the nature of activities, and protect financial organizations from risks and threats. AI's contribution to stabilizing and securing financial systems will increase as technology advances, providing more possibilities to address emerging risks that were hardly predicted.

The financial industry is applying AI significantly in fraud prevention, enhancing security, and reducing risk. The pie chart in Figure 5 shows how AI assists financial institutions in detecting fraud, estimating risks, and adhering to regulations. Other applications include credit risk assessment and customer-differentiated analysis, which helps make informed credit decisions in financial services. AI also enhances operations by removing manual delays and removing delays associated with manual operations. Additionally, robot advice is emerging, providing clients with investment advice at a lower cost than traditional financial advisors. However, AI-based solutions are commonly accepted to enhance security, support better decisions, and optimize risk management in the finance sectors.

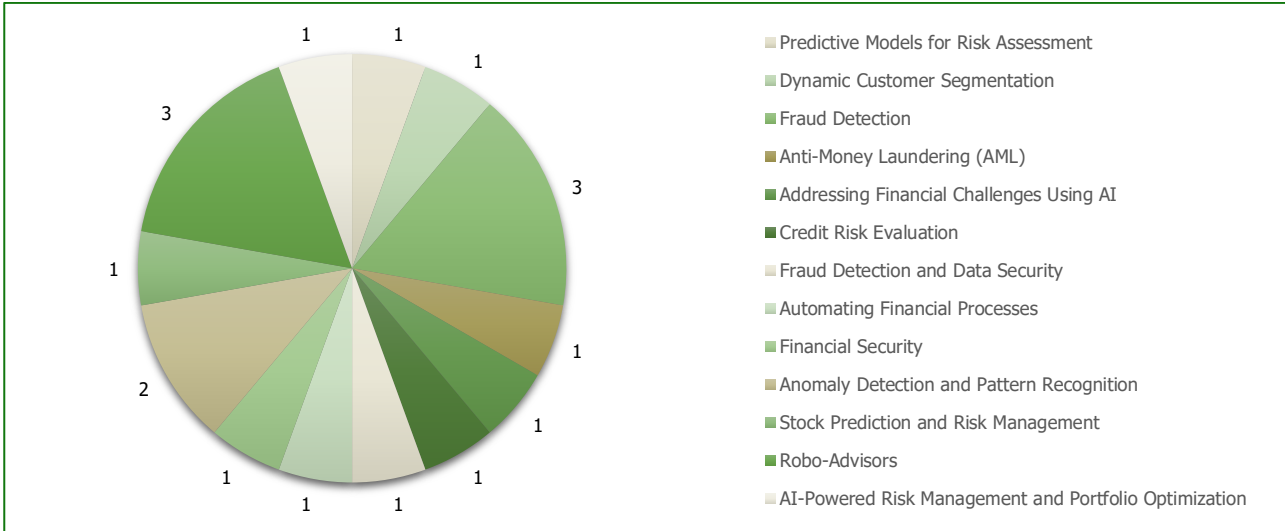


Figure 5. Distribution of AI Applications in Financial Risk and Security.

### Statistical Analysis

#### AI-Based Studies

The forest plot for AI-based studies (Figure 6) shows that AI has a strong positive impact on financial risk management, with an effect size of 1.07 (95% CI: 0.33, 1.80,  $p = 0.001$ ). This means AI significantly improves how financial risks are assessed and managed. The results are statistically strong, confirming AI's role in making risk-related decisions more effective. However, there is some variation among studies ( $I^2 = 96.97\%$ ), likely due to differences in how AI is applied. Overall, the findings highlight AI as a valuable tool for financial risk management, offering great potential for future improvements and innovations.

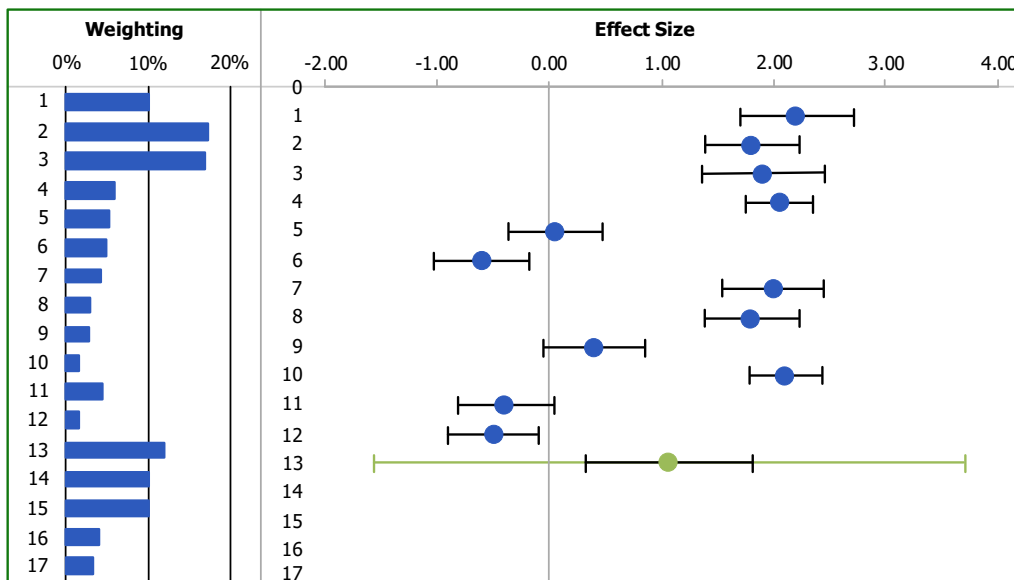


Figure 6. AI-Based Studies Forest Plot based on Effect sizes of AI on financial risk management.

The publication bias assessment using the Trim-and-Fill method identified no missing studies, indicating a low risk of bias, as shown in Figure 7. The funnel plot appeared symmetrical, and the adjusted effect size remains consistent at 0.05, suggesting that small-study effects or selective reporting are unlikely to influence the findings. However, the high heterogeneity ( $I^2 = 96.97\%$ ) indicates substantial variability across studies. Egger's regression test did not detect significant publication bias ( $p = 0.366$ ), with an intercept of -9.09 (95% CI: -30.23 to 12.05). Similarly, Begg and Mazumdar's test (Kendall's Tau = -0.08,  $p = 0.366$ ) further supports the absence of bias.

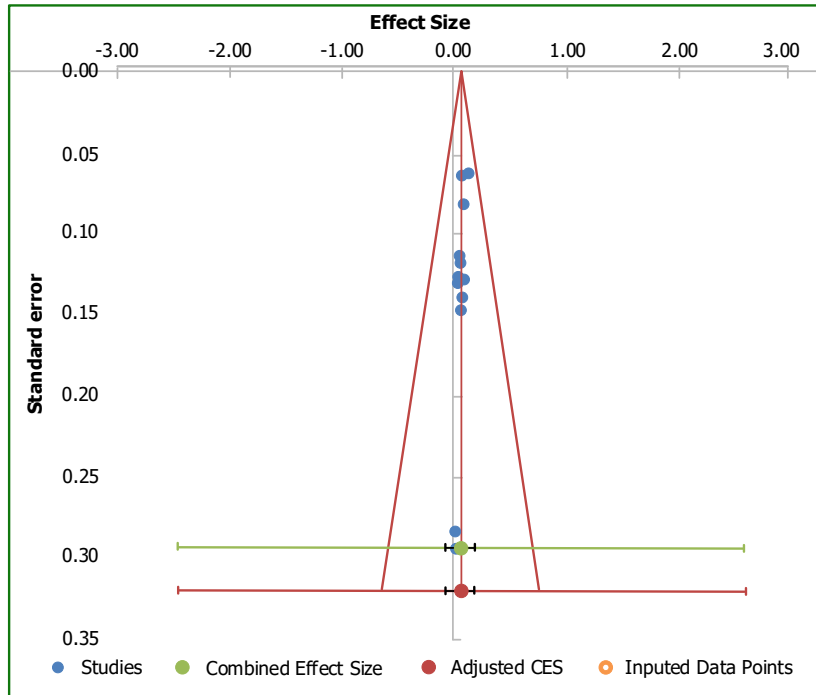


Figure 7. Funnel Plot for AI-based studies.

*Blockchain-Based Studies*

The results of the meta-analysis (Figure 8) suggest a positive impact of blockchain-based approaches on financial risk management, with a pooled effect size of 1.07 (95% CI: 0.33, 1.80). The statistical significance ( $p = 0.001$ ) supports blockchain's potential in this domain. However, the high heterogeneity ( $I^2 = 96.97\%$ ) indicates variability among studies, suggesting that effects may differ based on context and implementation. The prediction interval (-1.56 to 3.69) highlights some uncertainty, but the overall trend leans toward a beneficial influence. While further research is needed, these findings provide encouraging evidence for blockchain's role in improving financial risk management.

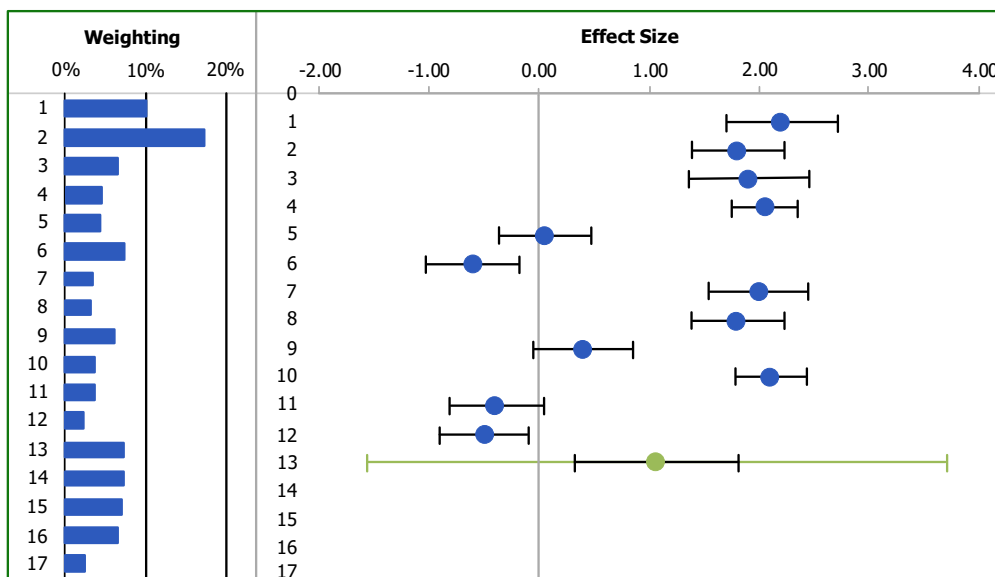


Figure 8. Forest Plot based on blockchain-based studies on Effect sizes on financial risk management.

The funnel plot in Figure 9 shows a symmetrical distribution of studies, suggesting minimal publication bias. The combined effect size is 1.06 (95% CI: 0.93 to 1.19), with no imputed missing studies using the Trim and Fill method. Egger's regression test ( $p = 0.366$ ) and Begg & Mazumdar's rank correlation test ( $p = 0.366$ ) indicate no significant small-study

effects. However, high heterogeneity ( $I^2 = 96.97\%$ ) suggests substantial variation among studies. Prediction intervals (-1.46 to 3.58) highlight uncertainty in future study effects. Overall, while bias appears low, heterogeneity suggests differences in study populations, methodologies, or interventions that should be further explored.

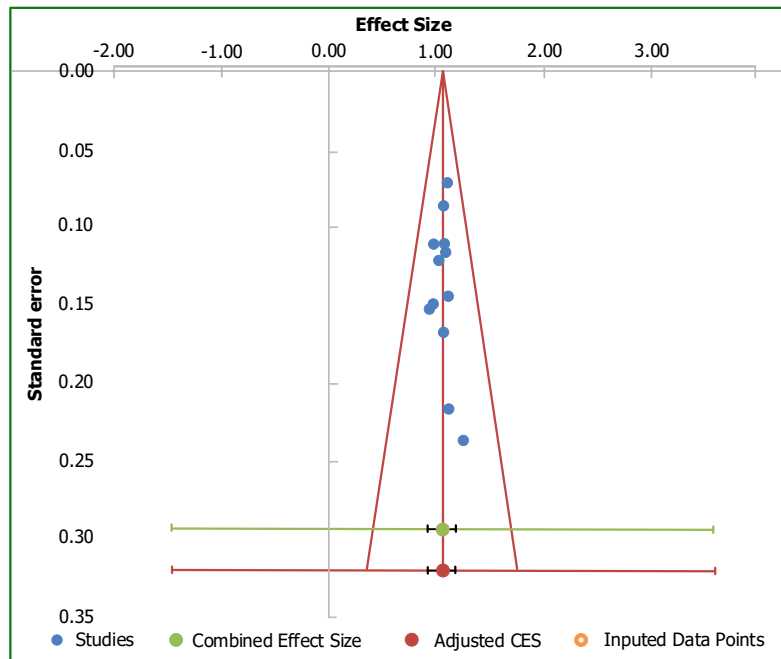


Figure 9. Funnel Plot for Blockchain-based studies.

### Theoretical Analysis

#### Artificial Intelligence

Incorporating AI within the financial services sector has transformed conventional practices, enabling financial institutions to enhance their decision-making and operational processes. AI-driven applications, such as robo-advisors, are redefining investment strategies by providing personalized and cost-effective financial advice rooted in advanced algorithms (Belanche et al., 2019). These robo-advisors employ AI to alleviate behavioural biases that often influence investment decision-making, resulting in a more objective approach to portfolio management and asset allocation. Research indicates a dual character of robo-advisory systems, asserting that while fully automated platforms demonstrate efficiency, a hybrid model that integrates human expertise more effectively addresses customer needs, particularly in complex decision-making contexts.

AI has shown potential in managing credit risk, particularly in emerging economies, by utilizing machine learning techniques (Scott et al., 2024). These AI models can analyze alternative data sources, including publicly available information, thereby overcoming traditional challenges associated with credit assessment and fostering financial inclusion for underbanked populations. This phenomenon suggests that AI's capability to process diverse datasets empowers financial institutions to perform thorough risk assessments, ensuring that even marginalized individuals can access credit.

AI's predictive capabilities have yielded significant advancements in the fraud detection domain. Machine learning algorithms that can identify real-time anomalies have rendered traditional rule-based systems less effective, reducing false positives and enhancing financial security (Javaid, 2024b; Nimmagadda, 2021). Furthermore, AI techniques, such as deep learning models, have proven proficient in detecting intricate fraudulent patterns within extensive datasets. This transformative capability not only reshapes the landscape of fraud detection but also adapts to emerging fraudulent techniques, consequently mitigating operational risks and minimizing financial losses (Gayam, 2021; Mohan et al., 2024; Potla, 2023).

#### Blockchain Technology

Blockchain technology, initially popularized through the advent of cryptocurrencies, has subsequently found various applications within the financial sector to deliver distinct advantages concerning transparency, security, and decentralization (Varma, 2019). The technology, also known as a decentralized ledger in blockchain, is an alternative to traditional centralized financial systems, particularly in scenarios marked by crises that have weakened trust in conventional institutions.

The global financial crisis, for instance, vulnerabilities associated with traditional banks and financial institutions, resulted in an increased interest in blockchain's capacity to function without any failure (Dashottar & Srivastava, 2021; Mishra & Kaushik, 2023).

In supply chain finance, blockchain has demonstrated its efficacy as a robust solution to enhance visibility and accountability. It proves particularly beneficial in managing risks under volatile business conditions, including crises and pandemics, by providing transparency alongside secure and traceable transactions. The incorporation of blockchain technology into supply chain finance not only mitigates risk but also refines decision-making processes through the assurance of data integrity and accuracy (Chowdhury et al., 2023; Mohan et al., 2024).

Islamic finance has emerged as a distinctly aligned sector with blockchain technology. The transparency and security that blockchain offers are congruent with Shari'ah principles, fostering trust among financial participants. Furthermore, implementing blockchain-based smart contracts within Islamic finance introduces a Shari'ah-compliant framework for the automation and security of financial transactions, consequently reducing operational risks and bolstering the reliability of credit assessments. These smart contracts effectively eliminate the uncertainties traditionally associated with conventional agreements, thereby facilitating compliance with Islamic law (Atova & Tayachi, 2019).

### **Comparative Analysis of Blockchain and AI**

With risk management in the context of the financial sector, both AI and blockchain technologies have distinct advantages and limitations. AI is highly effective in predictive analysis and continuous and progressive customer categorization, as has been found in Javaid (2024a), which discusses the application of AI in analysis and decision-making processes (Javaid, 2024a). Machine learning models are relatively efficient in handling large amounts of data to find patterns and deviations, which improves risk management approaches. For instance, Javaid (2024b) provides a real-life example of how, currently, artificial intelligence greatly enhances accuracy in fraud detection in real-time (Javaid, 2024b). However, issues like data quality, transparency, and the 'black box' nature associated with many AI applications can be limitations.

Moreover, blockchain technology has unique features that make its applicability in increasing transparency and security of financial transactions more suitable. Some examples of blockchain benefits described by authors are cost reduction and increased security, which ensure the formation of trust between participants, such as in Mishra & Kaushik (2023) (Mishra & Kaushik, 2023). This is especially helpful in industries such as credit risk assessment, where timely and accurate information sharing reduces risks significantly (Li, 2023). However, one of the significant challenges that have emerged when applying blockchain to an already existing financial system is scalability and regulation, as observed by Chang et al. (2020) and Varma (2019) (Chang et al., 2020; Varma, 2019). The issues affecting the progression rate of technology in the financial sector are weak processing capacities and those arising from implementing regulatory measures.

#### *Multi-Criteria Decision Analysis (MCDA) for AI and Blockchain*

To assess the effectiveness of AI and blockchain in managing financial challenges, a Multi-Criteria Decision Analysis (MCDA) was conducted using four critical evaluation criteria: Practicality, Expandability, Protection, and Speed. These criteria were weighted explicitly according to the needs of different financial issues; this means that only the most important aspects were considered, with priorities set according to the needs of particular domains. For example, in the application of fraud detection, the level of security concern was ranked higher (0.4) than that of efficiency (0.3), while cost and scalability were considered less important factors (0.2 and 0.1, respectively). Moreover, an essential factor for cross-border payments was scalability, with a score of 0.4, which showed how important it is to have a safe and efficient system when handling many transactions. They scored AI and blockchain technologies on a scale of 1 to 5 for each criterion, evaluating how well each technology addresses that criterion in the context of different financial problems.

The weighted summation formula was utilized, allowing us to rank each technology's effectiveness based on a numerical evaluation.

$$Total\ Score = \sum (W_i \times S_i)$$

The process included the distribution of ratings from 1 to 5 to each of the specified categories of the financial challenge concerning AI and blockchain technologies (Table). The key strength of AI was found to be in delivering performance efficiency, including the immediate identification of fraudulent transactions or complex data patterns, which translated into higher rates of fraud identification and credit rating. However, blockchain provided better security and data integrity results, scoring higher in cases where security and prevention of any data alteration were essential. While credit scoring

was also aligned with AI's strengths in big data analysis for accurate predictions, the possibility of incorruptible records was a significant value proposition of blockchain.

Blockchain led cross-border payments because of its scalability and intrinsic security in bearably international transactions. The reason was that blockchain is a primary technology for supply chain finance, particularly when tracking transactions in large and intricate supply chain networks. In the regulatory compliance context, AI also proved to be flexible and good at processing jobs because of the ability to adjust to changing regulations.

**Table 5. Multi-Criteria Decision Analysis (MCDA) Scores for AI and Blockchain in Various Financial Challenges.** Note: \* - the comprehensive table from the Multi-Criteria Decision Analysis (MCDA) comparing AI and blockchain for each financial problem

Financial Problem	Technology	Cost	Scalability	Security	Efficiency	Weighted Score
Fraud Detection	AI	4	3	4	5	4.0
	Blockchain	3	3	5	4	4.0
Credit Scoring	AI	3	3	4	4	3.6
	Blockchain	2	3	5	3	3.4
Cross-border Payments	AI	2	4	3	3	3.2
	Blockchain	3	5	5	3	4.4
Supply Chain Finance	AI	3	4	4	3	3.6
	Blockchain	3	5	5	4	4.4
Regulatory Compliance	AI	3	3	4	4	3.6
	Blockchain	4	4	5	3	4.1*

The analysis suggested that AI is most suitable for applications with high regression complexity and short decision-making cycles, such as fraud detection and credit scoring. Moreover, blockchain is most useful where the integrity of records is paramount, where there is a need to show data transparently, or where the data has to be secured, as in the case of cross-border payments and regulatory compliance. This complementary relationship implies that combining the best features of AI and blockchain, combining the speed of AI decision-making with the security of blockchain structures in the financial industry would result in the most effective solution for financial risk management.

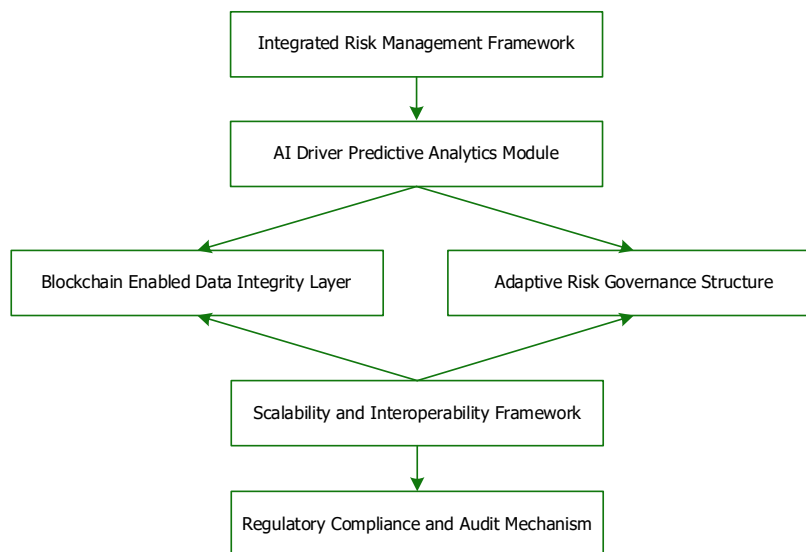
### *Theoretical Implications and Practical Applications*

The analysis of this study indicates that a hybrid integration of AI and blockchain technology may yield the most comprehensive solutions within the financial services sector. The predictive capabilities of AI can be effectively combined with the secure infrastructure provided by blockchain, thereby facilitating the development of a more resilient financial ecosystem. For instance, AI systems can identify fraud risks in real-time, while blockchain technology guarantees all transactions' transparency and tamper-proof nature. This synergistic combination effectively addresses the inherent shortcomings of both technologies, thereby providing a holistic framework for risk management and enhancing operational efficiency (Karger, 2020).

The reviewed studies highlighted the importance of developing governance structures that would respond to the new challenges posed by these enhanced technologies. AI and blockchain necessitate appropriate oversight mechanisms to mitigate data integrity risks and ensure compliance with regulatory standards. Future research should prioritize formulating standardized methodologies for integrating AI and blockchain within financial contexts, ensuring these technologies are scalable, secure, and ethically sound.

### *Theoretical Framework*

The Integrated Risk Management Framework (IRMF), introduced in this study as Figure 10, is an innovative approach to improving risk management in the financial industry by leveraging AI's potential, specifically predictive analytics and blockchain technologies for data securities. While AI has excellent command at recognizing risk patterns and mitigating possible risks, researchers have reported that using AI introduces issues such as data quality and hidden AI decision-making structures that need to be supervised by ethicists. Moreover, blockchain guarantees trust and transparency by recording decentralized transactions that can only be altered through very complex processes, which are essential, especially in credit risk assessment. The IRMF also proposes adaptive governance to facilitate an organization's ability to adapt to changes in financial risks while maintaining compliance with the law and ethical practices. This framework represents a quantum leap from conventional systems as it integrates two of the most powerful engines, AI and blockchain, but the level of its practical activity depends on several technical factors: the openness of AI models and the growth of blockchain.



**Figure 10. Integrated Risk Management Framework (IRMF) Utilizing AI and Blockchain for Enhanced Financial Risk Management.**

### Comparative Analysis

Three established risk management frameworks were selected to effectively compare the Integrated Risk Management Framework (IRMF) with traditional methods, including COSO ERM, ISO 31000, and Basel III. These frameworks were chosen due to their widespread adoption, influence, and relevance in the financial sector. The comparative analysis of this framework with IRMF is represented in Table 6.

Table 6. Comparative Analysis: IRMF vs. Real-World Risk Management Frameworks.				
COSO ERM Framework	ISO 31000	Basel III	IRMF	IRMF Advantage
<b>Data Analysis</b>				
Focuses on qualitative risk assessment	Primarily qualitative risk analysis with guidelines	Quantitative risk modelling for banking institutions	AI-driven predictive analytics for real-time, dynamic risk detection	More accurate, adaptable, and proactive risk management
<b>Data Security</b>				
It relies on traditional, centralized data storage	It does not emphasize data security	Centralized risk data aggregation requirements	Blockchain-enabled data integrity with tamper-proof records	Higher transparency, security, and reduced risk of data manipulation
<b>Decision-Making</b>				
Manual and structured risk assessment processes	Emphasis on leadership-driven decision-making	Quantitative metrics for decision-making	AI-powered automated decision-making based on large data sets	Faster, unbiased, and data-driven decision-making
<b>Compliance &amp; Auditing</b>				
Requires structured internal controls	Promotes compliance through risk guidelines	Heavy regulatory focus on capital adequacy	Automated auditing with blockchain provides a secure audit trail	Streamlined compliance and faster audit processes
<b>Scalability</b>				
Limited flexibility with organizational structure	Flexible but not technologically integrated	Banking-specific, not easily transferable to other sectors	Designed for scalability with modular components	Easier integration with existing systems and expansion as needed
<b>Regulatory Adaptability</b>				
Structured for organizational compliance	General guidelines for risk adaptation	Focuses on financial regulations and banking standards	Adaptive risk governance for dynamic response to evolving risks	Increased flexibility to meet new regulatory standards
<b>Fraud Detection</b>				
It relies on internal controls and periodic reviews	There is no specific focus on fraud detection	Encourages robust internal controls for fraud prevention	AI-based real-time fraud detection and pattern recognition	More effective fraud prevention and quicker response times
<b>Cost Efficiency</b>				
Manual processes increase operational costs	Emphasizes effective resource use	High compliance costs due to stringent requirements	AI and blockchain reduce manual interventions and streamline processes	Lower long-term costs and increased operational efficiency
<b>Interoperability</b>				
Not technology-focused, limited system connectivity	Focus on risk communication within an organization	Limited to financial institutions and compliance with banking standards	Scalability and interoperability framework for seamless integration	Enhanced collaboration and data sharing across platforms

### Applications of IRMF

To understand the real-world application of the IRMF, Table 7 comprises specific examples of how AI and blockchain can be utilized in various areas of the finance industry. The following Table 7 applications highlight examples of how the proposed IRMF can improve risk management, decision-making, and data security to address the difficulties experienced by conventional financial systems.

Table 7. Real-World Applications of the Integrated Risk Management Framework (IRMF) in Financial Sectors with Benefits.		
Financial Sector	Application of Theoretical Framework (IRMF)	Benefits
<b>Banking</b>	AI-driven fraud detection and customer classification Blockchain for secure credit risk assessments Predictive analytics for market trends and investment strategies	Reduces fraud losses and enhances trust More accurate risk assessments Optimized investment portfolios with real-time data
<b>Supply Chain Finance</b>	AI for predictive analytics in inventory management Blockchain for transparent tracking of goods and transactions	Minimizes stockouts and excess inventory Enhances supply chain visibility and trust between partners
<b>Insurance</b>	AI-based customer profiling for personalized insurance plans Blockchain to securely validate claims	Improved customer satisfaction with tailored plans Faster and more secure claims processing
<b>Investment and Asset Management</b>	AI for predicting stock performance and risk exposure Blockchain for securing transactions and verifying asset ownership	Increases return on investment with more innovative strategies Enhances security and authenticity in asset transactions
<b>Retail Banking</b>	AI to provide personalized financial advice and recommendations. Blockchain for secure customer data storage	Enhanced customer satisfaction through customized services Reduced risk of data breaches
<b>Credit Scoring</b>	AI to analyze alternative data sources (social behaviour, transaction history) Blockchain to store immutable credit history	More accurate credit scoring, reducing default rates Greater transparency in credit decision-making
<b>Regulatory Compliance</b>	AI for monitoring transactions to detect money laundering Blockchain for creating a secure audit trail for regulatory compliance	Improved compliance with regulations Transparent, easily traceable records for audits
<b>Trading Platforms</b>	AI for detecting unusual trading patterns (fraudulent trades) Blockchain to secure trade data and ensure transparency	Enhanced market stability and reduced manipulation risks Transparent and immutable trade records
<b>Wealth Management</b>	AI to create customized wealth management plans. Blockchain for secure and verifiable digital asset transactions	More personalized client portfolios Higher security in handling digital assets
<b>Microfinance</b>	AI will assess the loan eligibility of underserved populations. Blockchain to ensure secure, transparent microloan transactions	Broader access to financial services Increased trust and reduced risks for both lender and borrower
<b>Crossborder-Payments</b>	AI will detect unusual transaction patterns for fraud prevention. Blockchain for faster, more secure international payment transfers	Reduced transaction costs and times Greater transparency and security in international transactions

### Future Challenges

Integrating IRMF with AI and blockchain can generate challenges such as cost. Implementing AI-based analytics and blockchain infrastructure requires substantial initial investment, which may cause hindrances due to budget concerns. A phased strategy can mitigate these costs, focusing first on high-impact areas like fraud detection and credit scoring. Another challenge includes staff training and adaptation. Employees must adapt to new tools and processes introduced by AI and blockchain systems. Investment in training sessions and partnerships with technology experts can support this transition, ensuring long-term success and the development of in-house expertise (Cao, 2022).

Moreover, compatibility with existing technological infrastructure can also become challenging, as legacy systems may not easily support AI and blockchain functionalities (Bhumichai et al., 2024). Upgrading these systems can be costly and time-intensive. To overcome this challenge, middleware solutions can connect legacy systems with new technologies, allowing for a gradual integration without a complete overhaul. Scalability and interoperability are additional concerns, particularly in handling blockchain's transaction speed and network capacity (Hussain & Al-Turjman, 2021). The IRMF's modular design addresses these issues, providing a framework for gradual adoption while maintaining system integrity, ensuring it can adapt to evolving organizational needs without sacrificing efficiency.

### Limitations

The limitation of this meta-analysis can be the random selection of the studies, which might result in data heterogeneity. Different methodologies, scopes, and aim identification might affect the consistent integration of these technologies in financial services. Future research should focus on sector-specific meta-analyses that precisely compare the efficacy of AI and blockchain across specific financial sectors. This approach can enhance the generalizability of the findings.

### Future Directions

Future research should focus on sector-specific meta-analyses to compare the effects of both AI and blockchain with increased accuracy in the selected financial sectors. Moreover, stressing the use of standardized methodologies can also minimize data heterogeneity.

## CONCLUSIONS

The meta-analysis demonstrates that AI and blockchain are transformative for risk management in financial services. Blockchain offers transparency and security, effectively supporting identity verification and fraud prevention, while AI excels in predictive analytics for fraud detection and credit scoring. Although blockchain's impact on compliance remains limited, it strengthens data integrity, an essential feature in financial transactions. AI's predictive capabilities have empowered institutions to identify and manage risks proactively. Integrating these technologies can provide a robust framework for addressing emerging financial threats. Future research should focus on sector-specific applications to refine the future of AI and blockchain.

## ADDITIONAL INFORMATION

### AUTHOR CONTRIBUTIONS

*All Authors have contributed equally.*

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### CONFLICT OF INTEREST

*The Authors declare that there is no conflict of interest.*

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## РОЛЬ ФІНТЕХУ В ТРАНСФОРМАЦІЇ УПРАВЛІННЯ РИЗИКАМИ ТА ФІНАНСОВИХ ПОСЛУГ: СИСТЕМАТИЧНИЙ ОГЛЯД І МЕТААНАЛІЗ

Інтеграція штучного інтелекту та блокчейну у фінансові послуги трансформувала управління ризиками, забезпечивши розширене виявлення шахрайства, дотримання вимог і прогнозу аналітику. Однак у літературі існує значна прогалина щодо метааналітичного порівняння ефективності цих технологій у секторі. Дослідження має на меті подолати розрив шляхом проведення метааналізу, що оцінює вплив штучного інтелекту та блокчейну на різні аспекти управління фінансовими ризиками. Дослідження включає підхід метааналізу, систематично синтезуючи результати нещодавніх досліджень блокчейну та штучного інтелекту в управлінні фінансовими ризиками. Комплексний пошук

у Scopus і Google Scholar із дотриманням жорстких критеріїв включення призвів до відбору 36 досліджень для аналізу. Лісові ділянки та зведені таблиці були створені за допомогою Meta-Essentials, статистичного інструменту для метааналізу, який обчислює розміри ефектів, довірчі інтервали та об'єднані оцінки з використанням моделей фіксованих і випадкових ефектів для точної інтерпретації. Метааналіз показав, що технологія блокчейн підвищує фінансову безпеку та прозорість, особливо після COVID, усуваючи операційні ризики зі скромним, але незначним ефектом (HR = 1,04, 95% ДІ: 0,99-1,10,  $p = 0,11$ ). Штучний інтелект продемонстрував нейтральний вплив на управління ризиками (HR = 0,99, 95% ДІ: 0,94-1,04,  $p = 0,71$ ), але відзначився у виявленні шахрайства та прогнозній аналітиці. Аналіз воронкових ділянок показав мінімальну упередженість публікації, а лісові ділянки підтвердили послідовні результати в різних дослідженнях. Ці результати показали, що блокчейн підвищує прозорість і безпеку після COVID, пом'якшуючи фінансові цифрові загрози, водночас штучний інтелект перевершує виявлення шахрайства та прогнозну аналітику. Штучний інтелект революціонує управління ризиками за допомогою прогнозної інформації, а блокчейн забезпечує цілісність даних. Майбутні дослідження повинні уточнити галузеве застосування обох технологій.

**Ключові слова:** фінтех, штучний інтелект, блокчейн, фреймворк, виклики, фінансові послуги, управління ризиками

**JEL Класифікація:** G32, G17, O33, D81, E42