International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 4,2025
https://theaspd.com/index.php

Blockchain in Finance: Applications, Platforms, and Global Trends in a Decentralizing Ecosystem

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Abstract
The financial industry is undergoing a major transformation driven by advancements in Information Technology (IT), which demand greater transparency, security, and efficiency. Amid this evolution, blockchain has emerged as a disruptive force capable of addressing longstanding inefficiencies in traditional centralized financial frameworks. This study presents a detailed and systematic analysis of blockchain applications in finance, highlighting how its decentralized, immutable, and programmable features are redefining trust, data management, and automation in financial ecosystems. Drawing from a rigorous screening process of 4,695 articles from the Scopus database, the study narrows the focus to 194 peer-reviewed, open-access articles published between 2014 and 2025. The paper explores the application of blockchain across key financial domains such as capital raising, securities trading, investment management, financial analysis, credit scoring, insurance, real estate, and trade finance. It also examines 15 prominent blockchain platforms and their suitability for varied financial use cases based on architecture, privacy, throughput, and governance. Complementing the literature review, a bibliometric analysis identifies dominant research themes, influential contributors, and global collaboration trends. The findings indicate that blockchain's technical foundations—distributed ledgers, smart contracts, cryptographic protocols, and consensus mechanisms—offer scalable solutions for automating transactions, enhancing regulatory compliance, and improving financial inclusion. This study not only synthesizes existing research but also provides a roadmap for future innovation and scholarly inquiry in blockchain-enabled finance.
Keywords: *Blockchain, Decentralised Applications, Fintech and Security, Blockchain Applications and Digital Technology*

INTRODUCTION

The financial sector is undergoing a significant shift as a result of advances in information technology (IT), with the goal of meeting the increasing needs of a digitally integrated global economy (Gomber et al., 2018). This transition is distinguished by the rising complexity and diversification of financial applications, which pose a number of technological and operational issues for system developers and financial institutions (Zavolokina et al., 2016). Simultaneously, strict legal frameworks governing personal data security, trust assurance, and financial traceability put additional strain on innovators to assure compliance with global standards such as GDPR and AML/KYC regulations (Zetzsche et al., 2017). These two pressures, technology demand and regulatory compliance, need the creation of durable, transparent, and scalable financial infrastructures. In this rapidly changing environment, blockchain technology has emerged as a disruptive innovation, revolutionizing how financial systems are envisioned and implemented. Initially popularized through its role in enabling cryptocurrencies, blockchain introduces a decentralized framework that facilitates peer-to-peer transactions by eliminating the reliance on conventional financial institutions. intermediaries (Comert, 2020). By leveraging cryptographic protocols and distributed ledger systems, blockchain not only enhances transparency and trust in digital transactions but also addresses core inefficiencies inherent in conventional financial models. As such, it is increasingly viewed as a foundational technology capable of supporting next-generation financial services and infrastructure ((Natarajan et al., 2017).

Blockchain, powered by decentralized and distributed ledger technology, has gained prominence for its ability to ensure the security and integrity of transactions through cryptographically linked records, particularly within cryptocurrency networks (Catalini & Gans, 2020). However, its application extends well beyond cryptocurrencies. In the context of modern financial systems, blockchain offers innovative solutions to key challenges faced by financial institutions, such as lack of trust, inefficient data management, and limited process automation (Eyal, 2017). By leveraging decentralization, blockchain minimizes reliance on central authorities, enhances transparency, and ensures secure, tamper-resistant recordkeeping. These features make it a valuable technological framework for improving the efficiency, reliability, and resilience of financial ecosystems in the digital era. Trust in financial systems is built on strong moral foundations that influence consumer, enterprise, and regulatory confidence. Transparency in automated decision-making is essential for maintaining this trust, especially as traditional banking evolves into mobile and electronic platforms (Müller & Kerényi, 2019)). However, the increasing complexity and heterogeneity of digital banking applications have expanded the attack surface, making secure data management more critical than ever. In an era defined by vast volumes of sensitive consumer data, regulatory bodies have introduced frameworks like the GDPR to enforce data protection (Finck, 2018). Despite these efforts, practical challenges in implementation persist, hindering full compliance. Therefore, automating financial processes is vital not only for enhancing efficiency but also for ensuring scalability and trust in future financial ecosystems.

Automation has become a critical enabler of efficiency across various functions within financial ecosystems, streamlining processes such as credit evaluation, customer onboarding, fund transfers, and transaction processing with minimal human intervention. By leveraging real-time data analytics and intelligent decision-making algorithms, automation significantly reduces operational costs while enhancing accuracy and speed (Kunwar, 2019). In the financial industry, automated systems have transformed key activities including risk management, regulatory compliance, and financial reporting, enabling institutions to respond swiftly to dynamic market conditions. Notably, high-frequency trading platforms utilize algorithmic models to execute stock transactions within milliseconds, minimizing human error and maximizing profitability. Similarly, automated loan processing systems employ advanced data analytics and behavioral modeling to evaluate consumer creditworthiness, allowing for fast, paperless lending decisions. Automation also plays a vital role in ensuring regulatory compliance, with institutions deploying surveillance technologies to monitor transactions and adhere to complex regulatory standards. Against this backdrop, this paper examines how blockchain technology can complement and enhance automation in finance by offering decentralized trust mechanisms, secure and immutable data management, and self-executing smart contracts. Through a comprehensive review, this study contributes to ongoing academic and industry discourse, offering valuable insights for scholars and practitioners exploring blockchain's transformative role in the financial sector. Prior work by Abou and George (2023) has highlighted the relevance of blockchain applications in various domains, including finance, reinforcing the importance of this technological paradigm.

Recent studies have underscored the transformative potential of blockchain technology across various facets of the financial sector. Researchers have emphasized its capabilities in enhancing transaction processing, promoting sustainable banking, securing financial transactions, and enabling automation within financial services. Monrat et al. (2018) explored the wide-ranging applications of blockchain across multiple domains, highlighting its role in improving trade finance and stock exchanges through advanced security mechanisms. Zhang et al. (2019) introduced a blockchain-based financing instrument tailored for infrastructure projects in China, emphasizing features such as data immutability to enhance transparency and accountability in project financing. Almesha and Alhogail (2020) provided a comprehensive evaluation of adaptation models for blockchain across sectors such as finance, insurance, logistics, and healthcare. Specifically, in the financial domain, the study emphasized the emergence of Blockchain 2.0 and smart contracts as critical enablers for secure and autonomous execution of various financial operations, including property trading, securities settlement, supply chain finance, and anti-fraud mechanisms. Further, Zhang et al. (2021) explored the potential of blockchain in automating credit evaluations, fostering cooperative financial ecosystems, streamlining cross-border payments, and maintaining digital asset registries, while also acknowledging the regulatory and collaborative challenges at a global level. From a broader economic perspective, Nguyen (2022) analyzed the strategic role of blockchain in promoting sustainable financial development, highlighting its benefits for consumers and society at large. Collectively, these contributions illustrate the growing recognition of blockchain as a foundational technology for the future of financial systems. This study addresses the lack of a structured review on how blockchain technology is applied in financial domains. While many broad reviews exist, few have systematically explored blockchain's impact on areas such as capital raising, securities trading, investment management, and financial analysis.

To fill this gap, the paper surveys and synthesizes 194 open-access, peer-reviewed articles from the Scopus database, filtered using rigorous screening criteria. The study highlights how blockchain has revolutionized applied finance by enhancing transparency, reducing reliance on intermediaries, and improving operational efficiency. Special attention is given to the 15 most prominent blockchain platforms deployed in finance, with a detailed analysis of their features and use cases. The research also includes a bibliometric assessment, mapping out trends, key authors, collaboration networks, and thematic clusters—thereby offering a comprehensive view of current developments and emerging directions in blockchain-enabled financial systems.

Background

Centralized Financial Market Infrastructure: Structure and Limitations

Financial Market Infrastructure (FMI) serves as the structural foundation of modern economies, underpinning the efficient execution of transactions in capital markets. Within the conventional centralized model, key operations including the registration of securities, clearing, settlement, and payment processes are managed by major institutional entities such as the Central Securities Depository (CSD), Central Counterparty (CCP), Securities Settlement Systems (SSS), Payment Networks, and Data Repositories for transactions.. These entities form a collaborative ecosystem that ensures the smooth and compliant functioning of financial markets (Pavlát, 2015).

Each institution in this infrastructure plays a specialized role: CSDs manage investor account openings and record securities balances; brokers act as intermediaries submitting investor orders; transaction repositories match trades and initiate settlement instructions; payment systems facilitate fund transfers; and CCPs mitigate counterparty risk by interposing themselves between buyers and sellers. This ecosystem ensures operational stability and regulatory compliance through interconnected institutional processes.

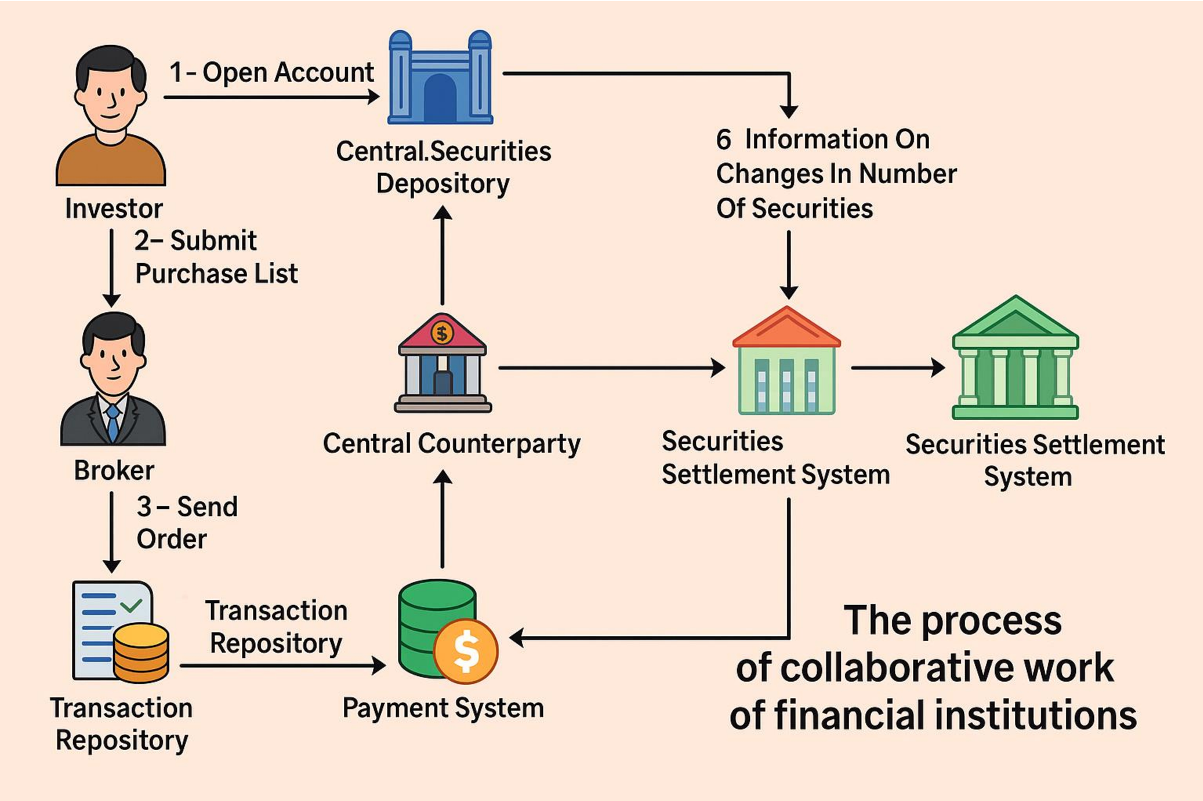

Fig. 1: Centralized Process of Securities Trading and Settlement

Source: Bank for International Settlements. (2022). Principles for financial market infrastructures: Disclosure framework and assessment methodology. Committee on Payments and Market Infrastructures.

Inherent Limitations of Centralized Financial Infrastructure

Despite its foundational role in ensuring transactional integrity and systemic stability, the traditional financial market infrastructure is architecturally centralized, which exposes it to several structural inefficiencies and systemic vulnerabilities. These limitations become more pronounced in a rapidly digitizing global economy that demands speed, transparency, and trust in financial operations.

a) Operational Cost Burdens

Centralized financial infrastructure imposes significant transaction costs due to its reliance on multiple intermediaries such as brokers, central counterparties (CCPs), and custodians. Each entity maintains its own proprietary ledger, necessitating duplication of records and reconciliation efforts that increase operational overhead (Gai et al., 2019). According to *Arner et al. (2016)*, post-trade processing in securities markets—settlement, reconciliation, and compliance—accounts for over 50% of total trade-related costs. The fragmentation of data across institutions leads to inconsistencies, increasing the risk of errors and necessitating expensive exception-handling procedures. This inefficiency particularly burdens retail investors and small financial institutions that lack bargaining power to negotiate lower fees, thus limiting financial inclusivity (Pop et al; 2018).

b) Liquidity Constraints and Settlement Delays

A major drawback of traditional infrastructure lies in its inability to provide real-time settlement. The settlement cycle in many markets follows a T+2 or T+3 system, wherein the actual exchange of cash and securities takes place two or three days after the trade is executed. These delays are largely attributed to the need for sequential verification by multiple entities—CSDs, payment systems, and custodians (Benos et al., 2019). The inter-institutional coordination required during cross-border settlements is even more cumbersome, often involving multiple jurisdictions, currencies, and banking systems. As noted by the *Bank for International Settlements*, such friction reduces the velocity of asset utilization, suppresses market liquidity, and introduces counterparty risk during the settlement lag period.

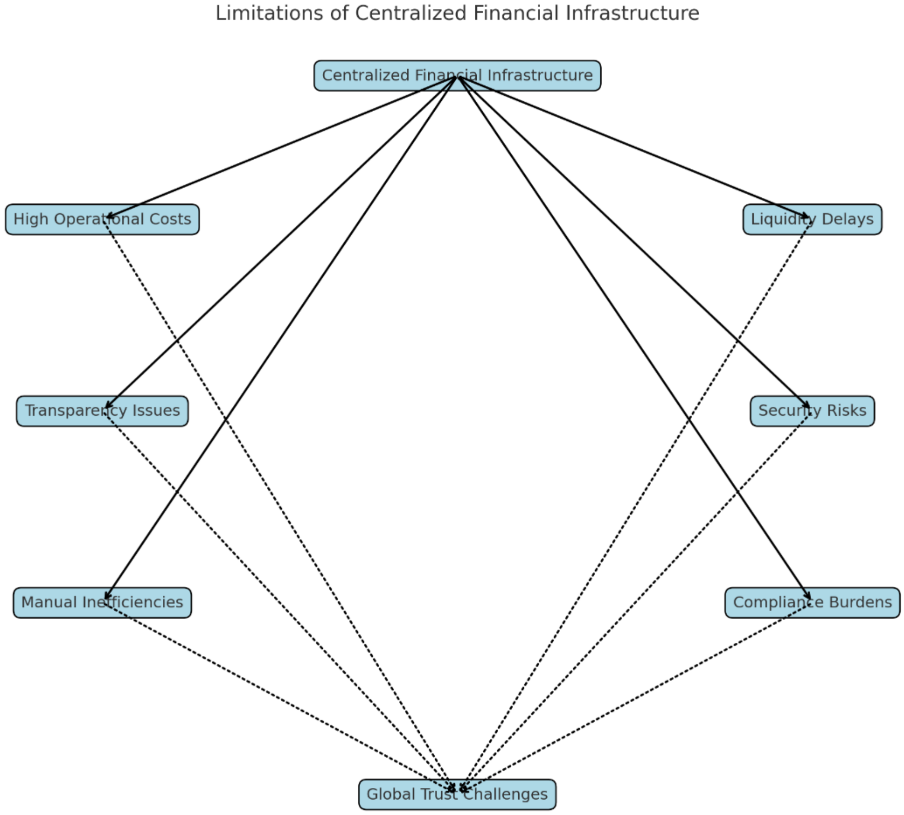

Fig-2: Limitations of Centralized Financial Infrastructure

Source: Author's Compilation

c) Transparency Deficiencies and Information Asymmetry

Traditional financial systems are notoriously opaque due to their closed architectures and lack of data interoperability. Clients often depend on intermediaries for trade execution, asset management, and reporting, but they are rarely granted real-time visibility into order books, settlement status, or the handling of their securities (World Bank, 2020). This can result in information asymmetry, which distorts price discovery, hinders informed decision-making, and raises concerns around agency conflicts and fiduciary mismanagement. Additionally, the proprietary nature of trading algorithms and custodial processes further limits transparency. According to *Gandal et al. (2018)*, the lack of auditability in institutional operations creates a fertile ground for market manipulation and undermines investor confidence, particularly in less regulated markets.

d) Security Vulnerabilities and Systemic Risk

Centralized infrastructures are susceptible to single points of failure, making them attractive targets for cyberattacks. A breach at a central counterparty, settlement system, or depository can have cascading effects, disrupting liquidity and damaging investor confidence across entire financial systems. The 2016 SWIFT network breach, which resulted in the theft of $81 million from the Central Bank of Bangladesh, highlighted how legacy systems often lack end-to-end encryption and robust multi-factor authentication. Moreover, the centralization of data and clearing services in CCPs concentrates risk in one institution. The *European Securities and Markets Authority (ESMA)* and the *Financial Stability Board (FSB)* have issued repeated warnings on the "too-big-to-fail" nature of CCPs, noting that a default by a major counterparty could threaten the broader financial system. The daily trading volumes in major markets now exceed trillions of dollars, and with over 200 million global investors (especially in retail segments like China and India), any breach or operational failure in these infrastructures can cause widespread panic, financial loss, and prolonged market closures.

e) Inefficiencies in Workflow and Manual Processes

Traditional securities trading involves a lengthy series of manual and semi-automated steps for opening accounts, verifying identities, placing orders, and reconciling records. Each transaction is subject to multiple handoffs between systems that often lack standardized communication protocols, resulting in delays, mismatches, and frequent need for exception handling. Furthermore, clearing and settlement functions depend on batch processing systems that are not optimized for real-time updates or high-frequency transactions. *Peters and Panayi (2016)* argue that this outdated architecture not only slows down trade completion but also imposes a hidden cost in terms of operational risk and lost investment opportunities during the lag. The inefficiencies are exacerbated in less-developed markets where digital infrastructure is still nascent, and manual data entry remains prevalent. These lags impact market responsiveness and weaken the overall competitiveness of national capital markets.

f) Regulatory Fragmentation and Compliance Burdens

In the centralized financial system, adherence to regulatory standards like Anti-Money Laundering (AML) and Know Your Customer (KYC) is ensured through autonomous implementation processes by each institution, leading to redundant processes, inconsistent data handling, and significant operational inefficiencies. This siloed approach requires financial institutions to invest heavily in compliance technology and personnel, yet offers only incremental improvements in fraud prevention and onboarding efficiency. The situation is further complicated by the fragmented nature of global regulatory frameworks. Divergent data protection laws—such as the GDPR in Europe versus sector-specific rules in Asia—create legal uncertainty and increase the risk of non-compliance in cross-border financial transactions. According to KYC Global Technologies, onboarding a corporate client in such contexts may take up to 90 days, burdened by excessive documentation and inter-institutional coordination. These constraints not only slow down transaction execution but also result in frictional losses and diminished accessibility, particularly for SMEs and new market entrants. As financial markets advance toward digitization and borderless interaction, the limitations of legacy infrastructure—centralized risk exposure, slow settlement times, and high compliance costs—become increasingly untenable. Blockchain-based financial systems offer a transformative solution to these challenges. By leveraging distributed ledger technologies (DLTs), smart contracts, and real-time consensus protocols, blockchain technology removes the reliance on centralized intermediaries and enables automated, verifiable, and transparent transaction records. This technological shift replaces institutional trust with algorithmic integrity, allowing for faster onboarding, enhanced security, and regulatory compliance through immutable audit trails. As a result, blockchain lays the foundation for a more efficient, accessible, and robust financial environment capable of meeting the demands of a globally connected economy.

Emergence of FinTech and Intelligent Technologies in Finance

The financial services sector has undergone a paradigm shift with the rise of Financial Technology (FinTech)—a convergence of innovative digital tools aimed at enhancing financial inclusion, transaction efficiency, and cost optimization. FinTech fosters automation, customization, and scalability through technological integration across core financial operations (George, 2024; Adeleke et al., 2022).

a) Artificial Intelligence (AI)

AI enhances financial decision-making by deploying predictive analytics, natural language processing, and machine learning in areas such as credit risk modeling, fraud detection, algorithmic trading, and robo-advisory services (Mishra et al., 2024). AI-driven automation accelerates operational workflows, reduces human error, and offers real-time insights for both retail and institutional investors.

b) Big Data Analytics

Big Data technologies process high-volume, high-velocity, and high-variety datasets to extract actionable intelligence. In finance, big data enables risk quantification, consumer behavior analysis, credit scoring, and investment optimization (Nuthalapati, 2022; Fang & Zhang, 2016). It enhances precision in market forecasting and portfolio allocation by mining unstructured and structured data from diverse sources.

Blockchain as a Disruptive Distributed Infrastructure

Originally conceptualized for Bitcoin, blockchain has evolved into a transformative infrastructure applicable across numerous financial operations. At its core, blockchain is a decentralized, cryptographically secured ledger maintained by a network of distributed nodes. Transactions are grouped into timestamped blocks and chained sequentially using hash functions, ensuring immutability and traceability.

Blockchain's decentralized structure eliminates reliance on central authorities, promoting peer-to-peer interactions and algorithmic trust. As such, it offers a promising alternative to traditional FMI by addressing key systemic limitations.

Blockchain as a Decentralized Transactional Framework

Blockchain represents a decentralized ledger technology that facilitates the documentation of transactions across a dispersed network of participants (Bacon et al., 2018), eliminating the dependency on centralized authorities. Unlike conventional financial systems that require banks or trusted intermediaries to validate and settle transactions, blockchain empowers users to transfer digital assets directly using secure cryptographic methods (Kaur & Sahu, 2025). For instance, when an individual (Party A) initiates the transfer of a digital token—such as a cryptocurrency—to another individual (Party B), the transaction is authorized via a digital signature created with Party A's private encryption key and then shared across the network. Every node in the network independently confirms the validity of the transaction by checking the cryptographic signature and ensuring alignment with previous transaction records (Aitzhan & Svetinovic, 2016). Once a majority consensus is achieved—typically using consensus algorithms like Proof of Work (PoW) or Proof of Stake (PoS)—the transaction is packaged into a newly generated block (Nguyen et al., 2019). This block is permanently added to the existing chain of records, forming a secure, immutable ledger. The decentralized and transparent nature of blockchain technology significantly accelerates transaction processing, lowers reliance on counterparties, and establishes a secure, trustless environment for conducting financial activities.

Structure and Security of the Blockchain System

Every block within a blockchain is composed of key information elements, such as transaction data—including the public addresses of the sender and recipient, the amount transferred, and the time of the transaction. In addition, it holds a distinctive cryptographic identifier (hash) for itself and the hash reference of the block that came before it (Zhai et al., 2019). This design upholds the security and consistency of the blockchain, as any modification to a block's content would result in a change to its hash, thereby disrupting the sequential linkage across the chain. For example, when an individual (Party A) sends 2 Bitcoins to another (Party B), this transaction, along with related metadata, is recorded in a newly generated block. This block is securely connected to the previous one—potentially documenting a separate transaction between, say, Party C and Party D—forming an unbroken sequence of data blocks. This continuous linking establishes a chronological and tamper-resistant digital ledger that is duplicated and maintained across all nodes in the system. The unchangeable nature of blockchain strengthens reliability, fosters transparency, and enables efficient auditing, making it exceptionally difficult to manipulate or falsify transaction records.

Implications and Applications Beyond Cryptocurrency

Although blockchain was first introduced by Satoshi Nakamoto in 2008 as part of the Bitcoin protocol, its applications have since expanded across various industries such as healthcare, real estate, finance, and supply chain management. The defining attributes of blockchain—its decentralized governance, immutability, and cryptographic security—position it as a transformative tool for digital recordkeeping and process automation. In the field of accounting, for example, blockchain's distributed ledger enables real-time transaction recording across all network participants (Eyo-Udo et al., 2025), thereby enhancing accuracy, transparency, and resistance to manipulation. Scholars such as Gietzmann and Grossetti (2021) suggest that permissioned blockchains, which do not require cryptocurrency, may offer even greater utility for business applications than public blockchain networks. As noted by Monrat et al. (2019), the potential of blockchain extends well beyond cryptocurrency, offering organizations a means to automate operational processes, ensure data integrity, and foster trust in multi-stakeholder environments. In contexts such as international trade—where transparency and trust are often limited—blockchain provides traceability and verifiability that can streamline processes and reduce operational risk. Blockchain has emerged as a game-changer in the centralized financial system by eliminating the need for intermediaries and enabling secure, transparent, and decentralized transactions. In contrast to conventional financial systems that depend on centralized entities to verify, process, and record financial activities, blockchain uses distributed ledger technology and consensus mechanisms to ensure trust and data integrity across a network of nodes. This innovation reduces transaction costs, increases settlement speed, and minimizes the risk of fraud or single points of failure. By offering real-time auditability and immutable records, blockchain redefines financial infrastructure, paving the way for more inclusive, efficient, and resilient financial ecosystems.

Foundational Technologies Underpinning Blockchain

The operational architecture of blockchain technology is built upon four foundational components that collectively ensure its functionality, reliability, and security: distributed ledger technology, consensus mechanisms, cryptographic protocols, and smart contracts. Each of these elements plays a pivotal role in enabling decentralized, trustless, and tamper-resistant systems for secure digital transactions.

a) Distributed Ledger Technology (DLT)

At the core of blockchain lies Distributed Ledger Technology (DLT), which facilitates decentralized data storage across a peer-to-peer network. Unlike conventional centralized databases that depend on a single authority for data management, blockchain replicates transaction records across all participating nodes in the network. Every participant node holds a complete version of the ledger, ensuring data redundancy, transparency, and system resilience. This decentralized architecture enhances fault tolerance, as the failure or compromise of one or more nodes does not affect the overall integrity or availability of the system. DLT thereby ensures continuity and data security without a central controlling entity.

b) Consensus Mechanisms

Blockchain networks utilize consensus algorithms to reach agreement among distributed nodes regarding the legitimacy of transactions. These protocols replace the need for centralized verification and maintain synchronization across the system. Prominent consensus models include: Proof-of-Work (PoW): Utilized by platforms like Bitcoin, the Proof of Work (PoW) protocol obliges network participants (miners) to perform intensive computational tasks in order to verify transactions and maintain network security. Though energy-intensive, it ensures high security through computational difficulty. Proof-of-Stake (PoS): In contrast to PoW, PoS selects validators based on the quantity of cryptocurrency they lock or "stake" as collateral. This approach significantly reduces energy consumption while incentivizing honest behavior.

c) Liquidity Constraints and Settlement Delays

A major drawback of traditional infrastructure lies in its inability to provide real-time settlement. The settlement cycle in many markets follows a T+2 or T+3 system, wherein the actual exchange of cash and securities takes place two or three days after the trade is executed. These delays are largely attributed to the need for sequential verification by multiple entities—CSDs, payment systems, and custodians (Benos et al., 2019). The inter-institutional coordination required during cross-border settlements is even more cumbersome, often involving multiple jurisdictions, currencies, and banking systems. As noted by the Bank for International Settlements (BIS, 2021), such friction reduces the velocity of asset utilization, suppresses market liquidity, and introduces counterparty risk during the settlement lag period.

d) Cryptographic Security

Blockchain leverages advanced cryptographic techniques to ensure data confidentiality, authenticity, and immutability. Two primary tools support this security infrastructure: Hash Functions: These are one-way mathematical functions that convert input data into a fixed-length alphanumeric string, known as a hash. Even a minor change in the input generates a drastically different hash, thereby making any tampering with recorded data easily detectable. Hashing also plays a critical role in linking blocks securely within the chain. Public-Private Key Encryption: Blockchain transactions rely on asymmetric encryption, where each participant holds a publicly shared key and a confidential private key. Data encrypted with a public key can be deciphered only using the associated private key, guaranteeing that only the intended and authorized party can access or validate the transaction information. This system enables secure peer-to-peer transactions while preserving user privacy and identity pseudonymity.

e) Smart Contracts

Smart contracts are autonomous, self-executing digital agreements embedded within the blockchain. Defined by programmable logic, they automatically enforce contractual conditions once predefined criteria are met. These scripts eliminate the need for intermediaries by automating tasks such as payment execution, asset transfers, and conditional access rights. Smart contracts enhance process efficiency, reduce transaction costs, and minimize the risk of human error. In practice, they are widely applied in financial settlements, decentralized finance (DeFi), supply chain traceability, insurance claims, and collateral management, offering verifiable, transparent, and tamper-proof execution of agreements.

Taxonomy of Blockchain Networks

Table 1: Blockchains differ in governance and accessibility, falling into three primary categories:

Type	Access	Governance	Performance	Use Case Suitability

Public Blockchain	Open to all (e.g., Ethereum, Bitcoin)	Decentralized, anonymous	Low throughput, high transparency	Ideal for cryptocurrency, NFTs, open DeFi ecosystems
Private Blockchain	Restricted to one entity	Centralized	High throughput, private	Used in enterprise operations (auditing, internal ledgers)
Consortium/Alliance Blockchain	Limited to approved entities	Shared governance	Balanced performance & privacy	Preferred for finance (e.g., supply chain finance, KYC, AML)

Source: Author's Compilation

Each blockchain type is suited to different compliance and scalability needs. Alliance blockchains are most compatible with regulated financial markets due to their hybrid nature, combining operational transparency with confidentiality.

Architectural Attributes of Blockchain Systems

Blockchain architecture is distinguished by a set of technical and structural attributes that underpin its operational efficiency, security, and transformative potential in digital ecosystems. These attributes include decentralization, immutability, transparency with pseudonymity, high availability, and process automation, all of which contribute to blockchain's effectiveness as a distributed trust infrastructure.

a) Decentralization

A defining characteristic of blockchain is its decentralized governance structure, wherein control and data validation responsibilities are distributed among multiple participants (nodes) across the network. This architectural model eliminates reliance on a single trusted authority or centralized intermediary, thereby removing single points of failure and reducing vulnerability to systemic disruptions (Atzori, 2015). Decentralization also fosters censorship resistance, enabling autonomous transaction validation and information exchange without susceptibility to external manipulation or unilateral control. By distributing trust across the network, blockchain enables secure and democratic data management in multi-party environments.

b) Immutability

Blockchain ensures data immutability by cryptographically linking blocks in a sequential, time-stamped manner (Komalavalli et al., 2020). Every block includes the cryptographic hash of its preceding block, creating an interdependent structure where even minimal alterations to any data point invalidate the entire chain (Zhai et al., 2019). This renders retroactive changes virtually infeasible unless a malicious actor gains control over the majority of the network—a scenario known as a 51% attack, which is extremely difficult and resource-intensive to execute in large-scale systems (Dwivedi et al., 2024). The immutable nature of blockchain guarantees long-term data integrity, making it ideal for applications that demand verifiable and tamper-resistant recordkeeping.

c) Transparency with Pseudonymity

Blockchain technology supports a transparent audit trail of all historical transactions, which are accessible to all participants in the network (Komalavalli et al., 2020). However, this transparency is carefully balanced with pseudonymity, whereby users interact through cryptographically secured public addresses rather than personal identifiers. This dual-layer approach ensures transactional accountability and traceability without compromising user privacy. The blend of visibility and anonymity enhances stakeholder trust and enables regulators, auditors, and counterparties to monitor compliance and detect anomalies without disclosing sensitive identity information.

d) High Availability and Fault Tolerance

Blockchain's decentralized architecture ensures strong system availability and resilience. Because every node holds a full replica of the ledger, the network remains fully functional even in the event of node failures or malicious attacks (Saad et al., 2008). This replication of data across geographically dispersed nodes increases the system's resilience to cyber threats, system outages, and localized failures, ensuring robust continuity and minimal downtime (Govea et al., 2024). As such, blockchain is particularly suitable for mission-critical applications requiring uninterrupted service and secure data retention.

e) Process Automation and Efficiency

Blockchain platforms integrate smart contracts—self-executing protocols encoded with predefined rules—that automate transactional processes (Toheeb et al., 2025). These digital agreements execute automatically when specified conditions are met, eliminating the need for manual oversight or intermediary intervention. This not only reduces operational costs and time delays but also enhances accuracy by minimizing the risk of human error or discretionary manipulation. In financial services, supply chains, and compliance workflows, smart contract automation facilitates real-time settlement, conditional payments, and dynamic record updates, thereby increasing overall efficiency and operational scalability.

Blockchain vs. Traditional FMI: A Strategic Shift

The transition from traditional FMI to blockchain-enabled systems reflects a shift from centralized to distributed models in financial infrastructure. Where traditional systems struggle with latency, costs, and security risks, blockchain introduces trustless verification, auditability, and real-time settlement.

Table 2: Comparison of Traditional Financial Market Infrastructure (FMI) and Blockchain-Based FMI

Feature	Traditional FMI	Blockchain-based FMI
Data Storage	Centralized databases	Distributed ledger across nodes
Intermediation	Multiple third-party institutions	Peer-to-peer with automated validation
Transparency	Limited, institution-specific	Publicly verifiable transactions (configurable)
Security	Vulnerable to data breaches and systemic risks	Cryptographically secured and immutable
Settlement Speed	T+2 or longer	Real-time or near real-time
Compliance	Manual, segmented	Programmable through smart contracts and digital identity

Source: Author's Compilation

As financial ecosystems grow in complexity and scale, the need for transparent, efficient, and secure infrastructures becomes critical. Blockchain, as a decentralized, cryptographically secured technology, offers a compelling alternative to traditional FMI by enhancing transparency, reducing operational friction, and fostering global trust. While legacy systems remain dominant in core functions, FinTech-driven innovations—especially blockchain, AI, and big data—are progressively redefining how financial transactions are conducted, verified, and settled. The integration of these technologies marks a transformative era in financial infrastructure, unlocking new models for automation, compliance, and interoperability.

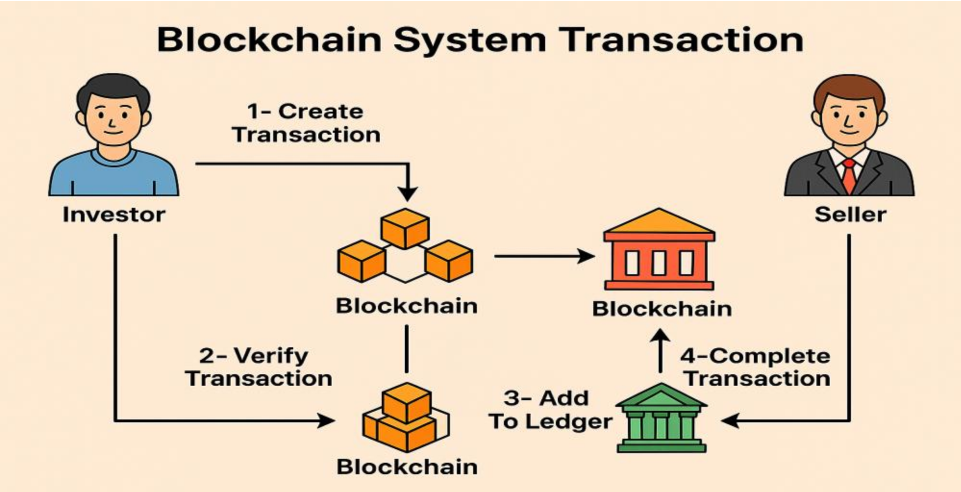

Fig-3: Process of Blockchain Transaction

Source: World Economic Forum, (2020).

Blockchain Platforms deployed in financial areas

The evolution of blockchain technology has given rise to a variety of platforms tailored for specific financial use cases, ranging from decentralized finance (DeFi) and tokenized securities to cross-border payments, central bank digital currencies (CBDCs), and institutional asset management. Each platform presents unique architectural and operational features, reflecting its suitability for public, permissioned, or hybrid financial environments. The following discussion provides a comprehensive examination of 15 prominent blockchain platforms and their deployment in financial applications.

Ethereum

Ethereum stands as one of the most extensively used public blockchain platforms and acts as the core infrastructure for a wide range of decentralized finance (DeFi) solutions. It facilitates smart contract functionality via its proprietary programming language, Solidity, allowing developers to build and launch decentralized applications (dApps) that operate independently on the Ethereum Virtual Machine (EVM) (Mukhopadhyay, 2018). Ethereum operates on a Proof-of-Stake (PoS) consensus mechanism, which has improved its energy efficiency and network scalability (Asif & Hassan, 2023). However, due to its default public nature, all transactions and smart contract data are visible to everyone on the network, which may raise privacy concerns for enterprise use. Despite its moderate transaction throughput (15–30 TPS), the network's capabilities can be enhanced via Layer 2 scaling solutions such as Optimism and Arbitrum (Vilá Brualla, 2023). Ethereum's robust developer community, extensive documentation, and widespread adoption have cemented its role in powering DeFi protocols like Aave, MakerDAO, and Compound, as well as in the tokenization of real-world assets (Cedra, 2024). Its open and composable architecture continues to attract institutional interest for innovation in financial products and services.

Quorum

Quorum is an enterprise-focused, permissioned blockchain platform initially developed by JPMorgan as a private version of Ethereum (Shevchenko & Lunsford, 2023). It is designed to support applications requiring high speed and throughput, enhanced privacy, and customizable consensus mechanisms. Quorum supports Solidity-based smart contracts and integrates privacy features through a component called Tessera, which facilitates private transactions between network participants (Robinson, 2018). Operating at approximately 200 TPS, Quorum offers scalability suitable for high-volume financial applications. Its governance is typically controlled by a consortium or enterprise, making it ideal for regulated environments such as interbank payments and tokenized financial instruments (Guimaraes, 2025). JPMorgan's Onyx and Interbank Information Network (IIN) are notable implementations of Quorum. The platform's compatibility with Ethereum's development tools allows seamless migration or dual-deployment for developers. Its strong emphasis on compliance, privacy, and performance positions Quorum as a key infrastructure for institutional blockchain solutions.

Corda

Corda, developed by R3, is a permissioned blockchain platform tailored for the financial industry (Mohanty, 2019). Unlike traditional blockchains, Corda does not broadcast transactions to all network participants. Instead, it uses a peer-to-peer architecture where only parties involved in a transaction can access the data, preserving confidentiality. Smart contracts in Corda are written in Java or Kotlin and are designed to reflect real-world legal agreements (Ismail, 2020). Corda employs a consensus mechanism based on notary nodes to validate transactions and prevent double spending (Brown, 2018). With high throughput and a strong privacy model, Corda is well-suited for use cases such as syndicated lending, insurance claim processing, and trade finance (Martino, 2021). Institutions like BNP Paribas, HSBC, and Finastra have adopted Corda to streamline operations, reduce costs, and increase transparency. The platform's ability to interoperate with existing legacy systems and its regulatory alignment make it a preferred choice for consortium-based financial applications.

Hyperledger Fabric

Hyperledger Fabric is a modular, permissioned blockchain framework developed as an open-source initiative by the Linux Foundation, tailored to meet the needs of enterprise-level applications (Mangrulkar & Chavan, 2024). It enables the use of smart contracts—referred to as "chaincode"—which can be written in widely-used programming languages like Go and Java (Baset et al., 2018). One of its standout features is the ability to define private channels, enabling selective data sharing among participants. Fabric's architecture separates transaction endorsement from ordering and committing, enhancing scalability and flexibility. The platform supports thousands of transactions per second (Ucbas et al., 2023), making it highly performant for use cases in trade finance, insurance, and supply chain finance (Gaur et al., 2020). Governed by the Linux Foundation, Hyperledger Fabric has attracted a broad range of enterprise users, including IBM Blockchain, we.trade, and ANZ Bank. Its fine-grained access controls and endorsement policies make it an excellent choice for institutions seeking high confidentiality, compliance, and integration with existing systems.

Ripple (XRP Ledger)

Ripple, based on the XRP Ledger, is a public blockchain platform optimized for real-time, cross-border payments and remittance services (Coutinho et al., 2023). Unlike smart contract-heavy platforms, Ripple is designed with a focus on transaction speed, cost efficiency, and liquidity provisioning (Trestioreanu, 2023). Its consensus mechanism is not resource-intensive and supports up to 1500 transactions per second with settlement times of 3–5 seconds. The platform lacks complex smart contract functionality but compensates with its efficiency and strong enterprise integrations. RippleNet, the network of financial institutions using Ripple's protocol, includes major players like Santander, SBI Ripple Asia, and PNC Bank. The use of XRP as a bridge currency helps institutions settle cross-border transactions without the need to pre-fund nostro accounts (Adrian et al., 2023). Despite ongoing regulatory scrutiny in some jurisdictions, Ripple remains a dominant player in blockchain-based payment infrastructure.

Stellar

Stellar is a public blockchain platform developed to facilitate low-cost, cross-border financial services (Khilji, 2023). It employs the Stellar Consensus Protocol (SCP), which enables fast finality and high throughput (up to 1000 TPS) without relying on energy-intensive mining (Gol

& Gondaliya, 2024). While Stellar offers limited smart contract functionality through basic scripting, its strength lies in the simplicity and efficiency of its payment and asset issuance processes. The platform is governed by the Stellar Development Foundation and is designed to support the needs of unbanked and underbanked populations (Zhuo et al., 2023). Use cases include microfinance, remittances, and stablecoin issuance, with notable implementations such as IBM World Wire and Circle's USDC. Stellar's open and accessible infrastructure makes it a strong candidate for building inclusive financial systems in emerging markets.

Symbiont Assembly

Symbiont Assembly is a permissioned blockchain platform purpose-built for institutional finance (Wu et al., 2024). It features a custom smart contract language called SymPL, designed to encode legally binding agreements with deterministic outcomes. Assembly is optimized for high-throughput, low-latency processing, making it suitable for complex financial instruments such as syndicated loans, bonds, and structured products. Unlike public blockchains, Assembly offers enterprise-grade privacy, auditability, and governance, aligning with regulatory requirements in capital markets. The platform has been adopted by leading institutions like Vanguard, Citigroup, and NASDAQ to improve transparency, efficiency, and automation in financial operations. By tightly integrating business logic with on-chain transaction workflows, Symbiont Assembly bridges the gap between traditional finance and blockchain-enabled automation.

Algorand

Algorand is a public, permissionless blockchain that delivers high-speed and low-cost transaction processing through its Pure Proof-of-Stake (PPoS) consensus mechanism (Muntaha et al., 2023). Capable of handling over 1000 transactions per second (Portal, 2022) with immediate finality, Algorand is well-suited for a variety of financial applications including central bank digital currencies (CBDCs), stablecoins, and asset tokenization. Smart contracts on Algorand are developed using TEAL (Transaction Execution Approval Language), which supports both Layer-1 and Layer-2 functionalities (Baratella, 2022). The platform's robust cryptographic foundations and focus on decentralization have attracted deployments like the Marshall Islands' digital currency and fintech projects across Latin America via Koibanx. Governed by the Algorand Foundation, the platform continues to evolve with features supporting zero-knowledge proofs and cross-chain interoperability.

Tezos

Tezos is a public blockchain platform recognized for its focus on formal verification and on-chain governance (Soudan, 2021). It uses a Liquid Proof-of-Stake (LPoS) consensus mechanism and supports smart contracts written in Michelson—a language that facilitates the mathematical verification of contract correctness (Singh et al., 2024). With moderate throughput (approximately 40 TPS), Tezos prioritizes security and protocol evolution over raw performance. Its on-chain governance model allows token holders to vote on protocol upgrades, reducing the risk of hard forks and ensuring community-driven development. Tezos has been adopted for applications in digital securities and CBDCs, with institutional support from organizations such as Societe Generale and Banque de France. Its emphasis on compliance, upgradability, and code safety makes it attractive for high-assurance financial use cases.

Avalanche

Avalanche is a public blockchain platform known for its high throughput, near-instant finality, and modular architecture (Hageli, 2024). It supports Ethereum-compatible smart contracts via the Avalanche C-Chain, while allowing developers to launch custom blockchain networks (subnets) tailored to specific application needs. With a transaction capacity of up to 4500 TPS (Sombat & Ratanaworachan, 2023), Avalanche is particularly suitable for asset tokenization, institutional DeFi, and gaming economies. Its consensus mechanism, Avalanche Consensus, enables scalable and secure transaction processing without compromising decentralization. Avalanche's governance is led by the Avalanche Foundation, and its ecosystem has seen deployments in financial services, including Deloitte's Close As You Go platform and tokenized investment products on Ryval. The platform's flexibility, speed, and EVM compatibility have made it a preferred choice for both retail and institutional blockchain applications.

Polkadot

Polkadot is a public blockchain platform designed to enable interoperability between multiple specialized blockchains, known as parachains (Burdges et al., 2020). These parachains operate independently but share security and consensus through the Polkadot Relay Chain. Polkadot supports custom smart contract development and offers high transaction throughput due to its parallel processing model (Pasham, 2023). Governance is managed by the Web3 Foundation and Polkadot Council, which oversee protocol upgrades and ecosystem development. Polkadot is particularly well-suited for decentralized finance (DeFi), multi-chain applications, and cross-chain asset transfers (Li, 2024). Projects like Acala and Moonbeam utilize Polkadot's infrastructure to deliver interoperable financial solutions. By connecting previously siloed blockchains, Polkadot enhances scalability and expands the functional scope of decentralized ecosystems.

Hedera Hashgraph

Hedera Hashgraph is a high-performance distributed ledger platform that employs a unique consensus algorithm called Hashgraph—a variant of asynchronous Byzantine Fault Tolerance (aBFT) (Alahmad et al., 2022). With a throughput of over 10,000 transactions per second and low-latency finality, Hedera is designed for enterprise-grade applications including micropayments, identity management, and ESG reporting. Unlike traditional blockchains, Hedera does not use blocks or mining; instead, it relies on a Directed Acyclic Graph (DAG) structure for efficient consensus (Amherd et al., 2023). Governance is maintained by the Hedera Governing Council, comprising leading global organizations such as IBM, Google, and Standard Bank. Hedera's deterministic fee model, data integrity, and scalability make it ideal for regulated financial applications and high-volume use cases.

EOSIO (Antelope)

EOSIO, now maintained under the Antelope protocol, is a public blockchain platform optimized for performance-intensive applications such as micropayments, gaming, and rewards systems. It supports smart contracts written in C++ and operates on a Delegated Proof-of-Stake (DPoS) consensus mechanism (He et al., 2020). EOSIO can handle thousands of transactions per second with minimal latency, making it one of the fastest blockchain platforms available. While its public nature limits privacy, its efficiency and developer tools make it a strong candidate for financial applications requiring fast execution and high throughput. The platform has been used in projects like Everipedia and Equilibrium, demonstrating its applicability in decentralized finance and real-time reward distribution. EOSIO's scalability and developer-friendly environment position it as a versatile infrastructure for a wide range of blockchain applications.

Table 3: Blockchain Infrastructure Comparison Across Financial Applications

Platform	Network Type	Smart Contract Support	Privacy & Confidentiality	Transaction Speed	Scalability	Use Case Focus	Governance	Financial Deployments

Ethereum	Public	✅ Solidity-based	❌ Public by default	⏱️ Moderate (15–30 TPS)	⚠️ Limited (Layer 2 needed)	DeFi, tokenization, DAOs	Decentralized (Proof of Stake)	Aave, MakerDAO, Compound, tokenized securities
Quorum	Permissioned	✅ Solidity-compatible	✅ Private transactions via Tessera	⚡ Fast (~200+ TPS)	✅ High	Interbank payments, tokenization, JPM Coin	Consortium or Enterprise-Controlled	JPMorgan (Onyx, IIN), LumenPay
Corda	Permissioned	✅ Contract-based (JVM)	✅ Peer-to-peer privacy model	⚡ Fast (BFT consensus)	✅ High	Syndicated loans, insurance, trade finance	Centralized or regulated consortia	BNP Paribas, HSBC, Finastra
Hyperledger Fabric	Permissioned	✅ Chaincode (Go/Java)	✅ Fine-grained access control	⚡ Very fast (>1000 TPS)	✅ Modular & scalable	Trade finance, insurance, supply chain finance	Managed by Linux Foundation	IBM Blockchain, we.trade, ANZ Bank
Ripple (XRP Ledger)	Public	❌ Limited	❌ Public transactions	⚡ Very fast (~1500 TPS)	✅ High	Cross-border payments, liquidity management	Ripple Labs with validators	Santander, SBI Ripple Asia, PNC
Stellar	Public	⚠️ Limited (basic scripting)	❌ Public ledger	⚡ Very fast (~1000 TPS)	✅ High	Microfinance, remittances, stablecoins	Stellar Development Foundation	IBM World Wire, Tempo, Circle (USDC)
Symbiont Assembly	Permissioned	✅ SymPL (custom language)	✅ Legal-grade smart contracts	⚡ High throughput	✅ High	Bonds, loans, legal contracts	Enterprise-led consortium	Vanguard, Citi, NASDAQ

Algorand	Public	✅ TEAL, Layer-1 contracts	❌ Public ledger	⚡ Fast (~1000 TPS)	✅ High	CBDCs, stablecoins, tokenized assets	Algorand Foundation	Marshall Islands CBDC, Koibanx
Tezos	Public	✅ Michelson (formally verifiable)	❌ Public ledger	⏱ Moderate (~40 TPS)	⚠ Moderate	Digital securities, CBDCs	On-chain governance	Societe Generale, Banque de France
Avalanche	Public	✅ Solidity-compatible	⚠ Public, subnets can be private	⚡ Very fast (~4500 TPS)	✅ Highly scalable	Asset tokenization, institutional DeFi	Avalanche Foundation	Deloitte, Ryval, tokenized equities
Polkadot	Public	✅ Parachain-specific	⚠ Depends on parachain config	⚡ Fast & parallelized	✅ Extremely scalable	Interoperable DeFi, multi-chain apps	Web3 Foundation, Polkadot Council	Acala, Moonbeam, DeFi bridge platforms
Hedera Hashgraph	Public-Permissioned	✅ Custom SDK (Java, Go)	✅ Fair ordering & fixed fees	⚡ Very high (>10,000 TPS)	✅ High	Micropayments, identity, ESG	Hedera Governing Council	IBM, Standard Bank, DBS Bank
EOSIO (Antelope)	Public	✅ C++-based smart contracts	❌ Public by default	⚡ Very fast (~3000 TPS)	✅ High	Micropayments, games, rewards	EOSIO Coalition	Everipedia, Equilibrium

Source: Author's Compilation

Blockchain applications in finance

Blockchain technology has introduced significant innovations across multiple domains within the financial sector. Its use cases extend to capital formation, securities exchange, financial analytics, and portfolio management. The subsequent sections delve into these areas, highlighting how blockchain is progressively redefining the landscape of contemporary financial systems.

Capital raising

A well-functioning securities market relies heavily on the availability of capital and the efficiency of capital-raising mechanisms. Traditionally, enterprises have relied on issuing securities to raise

capital. However, conventional capital-raising methods face several persistent challenges, including information asymmetry, lack of trust, complex issuance procedures, and limited liquidity (Liu et al., 2021). Blockchain technology, with its inherent features of decentralization, transparency, immutability, and enhanced security, offers a promising solution to these issues. In recent years, this has led to the development of Security Token Offerings (STOs)—a novel financing mechanism that integrates the structural rigor of traditional securities with the technological advantages of blockchain (Schletz et al., 2020). STOs aim to provide a more transparent, efficient, and inclusive capital-raising process by digitizing ownership of assets such as equity, debt, and funds. Unlike Initial Coin Offerings (ICOs), which gained popularity for their ease of use but drew criticism for their lack of regulation, STOs operate within existing legal frameworks and are designed to offer greater investor protection. As such, STOs attempt to bridge the gap between unregulated ICOs and highly regulated Initial Public Offerings (IPOs), merging the accessibility of digital finance with the compliance of traditional markets.
Central to the STO ecosystem are issuance platforms that facilitate the creation, compliance, and trading of tokenized securities. These platforms—such as Polymath, Securitize, Harbor, tZERO, and TokenSoft—leverage blockchain and smart contracts to manage security tokens throughout their lifecycle. For instance, Polymath, which operates on the Ethereum blockchain, allows issuers to launch compliant tokens using smart contracts while enforcing investor eligibility through Know Your Customer (KYC) processes. The issuance process involves multiple steps: token creation, legal validation, compliance setup, whitelist management, and secure trading—all executed transparently via smart contracts. Investors must be verified through approved KYC providers before participating in token purchases, and secondary sales are restricted to verified participants, ensuring regulatory adherence. The benefits of STOs include lower issuance costs, higher transaction transparency, improved investor trust, and enhanced liquidity of previously illiquid assets. Additionally, the immutability of blockchain records ensures auditability and reduces fraud, while the automation enabled by smart contracts accelerates execution and reduces reliance on intermediaries. As a result, STOs represent a transformative shift in capital markets by offering a secure, cost-effective, and programmable alternative for raising and managing capital in the digital age.

Securities Trading: The Impact of Blockchain Technology

The securities industry relies heavily on well-coordinated financial infrastructure, including central securities depositories, securities settlement systems, central counterparties, payment systems, and trading platforms. However, traditional securities markets are constrained by several structural inefficiencies—namely high transaction costs, limited liquidity, low transparency, and complex multi-party processes. Blockchain technology addresses these limitations by introducing a decentralized and distributed ledger system that eliminates the need for intermediaries, allowing for peer-to-peer trading. This transformation is paving the way for new blockchain-based financial infrastructures that enhance transparency, reduce costs, and streamline operations. Blockchain-driven innovations—such as decentralized payment networks and digital exchanges—are revolutionizing securities trading. Platforms like Nasdaq and the Bucharest Stock Exchange have started exploring decentralized trading frameworks, while blockchain-based clearing systems like SETLcoin promote data integrity and settlement security (Ryan & Donohue, 2017). Moreover, blockchain supports programmable payments and smart contracts that enable autonomous settlement, creating opportunities for digitized and intelligent securities markets. These advancements are pushing traditional markets toward digital transformation, promising greater efficiency, trust, and accessibility for all participants.

Blockchain-Based Payment Systems in Securities

Blockchain has significantly influenced payment systems within the securities industry through the introduction of digital currencies and decentralized clearing mechanisms. One prominent application is the development of Central Bank Digital Currencies (CBDCs), which use blockchain or distributed ledger technologies to offer transparent, secure, and programmable monetary transactions. According to the Bank for International Settlements (BIS), over 86% of global central banks are researching or piloting CBDCs (da Silva, 2022). CBDCs are categorized into two types: wholesale CBDCs—targeted at financial institutions for interbank transactions—and retail CBDCs—designed for public use. Wholesale CBDCs operate under a dual-tier model, where central banks issue the digital currency while commercial banks manage client-facing activities. These digital currencies enable real-time, conditional settlement of securities transactions, eliminating delays common in real-time gross settlement (RTGS) systems. They also offer programmable functionalities through smart contracts, allowing for highly automated payment instructions. On the other hand, retail CBDCs support financial inclusion by reducing the cost and complexity of cross-border and domestic transactions, especially in underserved regions. Despite their potential, CBDCs remain in early development stages, requiring further research to fully understand their implications for monetary policy, privacy, scalability, and financial stability.

Decentralized Trading Platforms

Securities trading platforms facilitate the buying and selling of financial instruments, often through brokerage firms, exchanges, or fintech providers. Traditional platforms face limitations related to latency, manual documentation, and lack of transparency. Blockchain-based trading systems overcome these by decentralizing trade execution, settlement, and verification. Nasdaq Linq, launched in 2015, is a prime example of blockchain's potential in equity trading. It uses a private blockchain to manage securities issuance, transfers, and settlements. It allows only authorized participants—like Nasdaq, the U.S. SEC, issuers, and investors—to access and verify transactions securely. Nasdaq Linq integrates smart contracts for automating equity lifecycle functions such as issuance, dividend distribution, and ownership transfer. This eliminates the need for paperwork and legal intermediaries, thus minimizing administrative overhead and human error. Importantly, blockchain reduces the typical three-day settlement period in equity markets to as little as ten minutes, significantly improving efficiency and reducing operational risk. Digital ownership records are immutable, traceable, and easily audited, offering stakeholders greater confidence and visibility into transactions. Overall, platforms like Nasdaq Linq exemplify how blockchain enhances the speed, transparency, and reliability of securities trading.

Blockchain-Driven Clearing and Settlement Systems

Clearing and settlement are critical stages in securities trading that ensure the buyer and seller fulfill their contractual obligations. Traditional systems involve multiple intermediaries and operate in sequential, delayed processes. Blockchain technology offers real-time, peer-to-peer settlement mechanisms that drastically reduce settlement cycles and improve transparency. One notable initiative is SETLcoin, introduced by Goldman Sachs, which uses blockchain for secure and efficient securities settlement.

SETLcoin employs smart contracts to verify transactions and a virtual wallet system to manage digital assets like stocks, bonds, and currencies. Instead of using SETLcoin as a currency, it acts as a digital token representing ownership of securities. SETLcoin utilizes the Practical Byzantine Fault Tolerance (PBFT) consensus algorithm to maintain ledger consistency and prevent double-spending. Furthermore, it incorporates sidechain technology to handle high transaction volumes and multi-signature security to prevent unauthorized access. The use of blockchain in settlement processes reduces the traditional cycle from days to seconds, ensuring that both financial and legal settlement occurs nearly simultaneously. This not only improves operational efficiency but also reduces counterparty and systemic risks. In conclusion, blockchain-based clearing systems such as SETLcoin illustrate how distributed technologies can modernize legacy infrastructure and provide a robust foundation for next-generation financial markets.

Financial analysis

Financial analysis within the securities sector entails a thorough evaluation of capital markets and trading activities, designed to support informed decision-making for both investors and financial institutions. Conventional methods of financial analysis are often hindered by challenges such as data vulnerability, questionable credibility, limited transactional transparency, and inefficiencies in analytical processing. Blockchain technology offers a compelling solution to these limitations due to its core characteristics of immutability and resistance to tampering. These attributes have contributed to its growing acceptance as a transformative tool in financial analysis, particularly within the securities industry where it is increasingly employed for secure and transparent data management. A prominent example is Symbiont, a blockchain-enabled financial services firm, which leverages its proprietary platform to enhance securities analysis. The system integrates artificial intelligence and machine learning to autonomously extract and interpret valuable insights from extensive datasets. It further incorporates blockchain infrastructure to provide asset management capabilities for securities issuers, significantly boosting data transparency and offering enhanced analytical resources to investors. Symbiont's decentralized framework, known as Symbiont Assembly, connects data contributors and users via a permissioned network that enables real-time exchange of verifiable, accurate information. This live index data network accelerates data dissemination by eliminating manual processes, thereby reducing operational risk. In this system, index data is transferred to nodes maintained by index providers through pre-established data generation mechanisms. Once received, the data undergoes automated validation via smart contracts, is encrypted, recorded on provider-hosted nodes, and distributed across the network. Only authorized participants with decryption keys can access the specific datasets, which are then relayed to downstream applications for further use. Overall, blockchain-powered financial analysis systems offer a decentralized, tamper-proof, and trustworthy framework for managing sensitive financial data. The traceability of blockchain records enhances regulatory oversight and transparency, while smart contracts contribute to higher levels of analytical accuracy, efficiency, and security.

Blockchain-Based Innovations in Investment Management

Investment management is a cornerstone of the securities industry, encompassing services provided by professional managers to allocate and manage clients' assets in line with specific investment goals. This process involves critical functions such as portfolio construction, asset allocation, risk management, market analysis, and client advisory, typically in exchange for management fees. Despite its importance, traditional investment management suffers from several structural issues, including high operational costs, opaque fee structures, limited transparency, and inflexible portfolio strategies. These inefficiencies often result in reduced investor confidence, especially in rapidly changing or decentralized market environments. With the advancement of blockchain technology, financial institutions and fintech startups are increasingly exploring decentralized investment management platforms. One notable example is Enzyme Finance (formerly Melon Protocol), a digital asset management protocol built on the Ethereum blockchain. Enzyme utilizes smart contracts to automate and govern the entire lifecycle of portfolio creation, execution, and reporting—without reliance on traditional intermediaries. Users can establish investment accounts by linking digital wallets such as MetaMask or Ledger, browse a marketplace of available portfolios, review their composition and historical performance, and allocate capital by purchasing portfolio tokens. Enzyme also supports real-time performance tracking, risk assessment, fee transparency, and on-chain asset rebalancing, giving investors direct control over their funds.

The platform's decentralized architecture ensures that investors retain custody of their assets and can interact with fund strategies without third-party gatekeeping. Moreover, its smart contract-based governance allows users to dynamically adjust their strategies, withdraw or reinvest funds, and monitor exposure in real time—ensuring adaptability to market conditions. When exiting a position, users can easily initiate a sell transaction via the platform interface, with asset liquidation and fund returns executed automatically through smart contracts. By eliminating manual processes and third-party dependencies, Enzyme Finance offers a cost-effective, secure, and highly customizable investment management framework. This not only improves investor autonomy and transparency but also sets a new benchmark for trustless, programmable asset management in the blockchain era.

Trade Finance: Enhancing Transparency and Efficiency through Blockchain

Trade finance underpins a significant portion of global commerce by facilitating payments, credit, and risk mitigation in cross-border transactions. However, the traditional trade finance ecosystem is heavily reliant on paper-based processes and manual verification, involving a complex web of intermediaries including banks, freight forwarders, customs authorities, and insurers. This results in high operational costs, delayed settlements, limited transparency, and increased vulnerability to fraud. Moreover, small and medium-sized enterprises (SMEs) often face restricted access to financing due to limited visibility and high counterparty risks. Blockchain technology addresses these inefficiencies by introducing a decentralized, tamper-resistant, and transparent ledger system that allows all parties to access and share trade-related data in real time. Smart contracts embedded within blockchain platforms automate key processes such as payment disbursement, shipment verification, and customs clearance—significantly reducing turnaround time and enhancing trust across the value chain.

Several blockchain-enabled platforms have demonstrated the transformative potential of this technology in trade finance. For instance, we.trade, built on Hyperledger Fabric, enables European banks and corporates to conduct secure trade transactions with automated compliance and payment execution. Similarly, the Marco Polo Network, based on R3's Corda, facilitates open account trade finance by digitizing receivables, payment guarantees, and working capital optimization. These platforms reduce document duplication, accelerate payment cycles, and improve auditability for all participants. By leveraging blockchain's core attributes—immutability, transparency, and decentralization—trade finance becomes more efficient, secure, and accessible, particularly for emerging markets and underserved enterprises. As adoption grows and regulatory clarity improves, blockchain is expected to become an integral infrastructure for global trade, fostering inclusive economic growth through enhanced capital flows and operational resilience.

Insurance and Claims Management: Driving Automation and Trust through Blockchain

The insurance sector, while vital for financial protection and risk management, is plagued by manual processing, delayed settlements, administrative inefficiencies, and fraud-related losses. Traditional claims management requires multiple layers of verification, document submission, and coordination between insurers, policyholders, underwriters, and adjusters, often leading to a lack of transparency and customer dissatisfaction. Blockchain technology introduces a decentralized and immutable system that can drastically improve operational efficiency, reduce fraudulent claims, and enhance customer trust. Through smart contracts, insurers can automate claims adjudication and payouts based on predefined terms embedded in digital policies. When integrated with real-time data inputs—such as weather conditions, medical reports, or IoT sensors—smart contracts can trigger immediate execution of policy conditions, enabling parametric insurance solutions that eliminate the need for manual claim assessments.

Several innovative platforms have adopted blockchain to reshape insurance delivery. For instance, Etherisc, a decentralized insurance protocol, offers blockchain-based flight delay and crop insurance products, where claims are processed and settled autonomously based on verified external data feeds. Likewise, B3i (Blockchain Insurance Industry Initiative), backed by major global insurers, focuses on improving reinsurance contract management, risk sharing, and data synchronization across stakeholders. Blockchain's shared ledger allows all parties to access a single version of the truth, ensuring data consistency, reducing disputes, and enabling secure audit trails. Furthermore, blockchain can enhance compliance with regulatory requirements, such as anti-money laundering (AML) and Know Your Customer (KYC), by storing identity and policyholder data in a secure yet accessible manner. As the insurance industry becomes more digitized, blockchain offers a transformative pathway to reduce costs, increase transparency, and improve the customer experience, marking a significant shift from reactive claims handling to proactive, automated insurance ecosystems.

Real Estate and Mortgage Financing: Transforming Property Markets through Blockchain

The real estate and mortgage financing industry is traditionally characterized by complexity, opacity, high transaction costs, and lengthy settlement cycles. Transactions typically involve numerous intermediaries such as brokers, escrow agents, title companies, and banks, each maintaining separate records and engaging in manual verification processes. This fragmentation leads to duplication of effort, information asymmetry, and an increased risk of fraud or title disputes. Blockchain technology offers a promising solution by enabling a secure, transparent, and tamper-proof digital ledger that records every stage of a real estate transaction—from property listing and buyer verification to contract execution and title registration. By utilizing smart contracts, blockchain can automate and enforce transaction conditions, such as payment terms, transfer of ownership, or loan disbursements, thereby reducing reliance on third parties, eliminating paperwork, and minimizing human error.

One of the most impactful applications of blockchain in real estate is tokenization of property assets. Tokenization involves converting the ownership of a physical property into digital tokens on a blockchain, allowing fractional ownership and enabling smaller investors to participate in real estate markets that were previously inaccessible. Platforms like RealT, Propy, and SolidBlock are leading this transformation by offering blockchain-based marketplaces for tokenized property investment and sales. On the mortgage side, blockchain can digitize and streamline the loan origination process, enabling faster approvals, secure identity verification, and real-time monitoring of repayment activities. For example, blockchain can integrate borrower credit history, income data, and collateral details into a single verifiable ledger, significantly reducing underwriting time and improving risk assessment. Additionally, blockchain-based mortgage registries can eliminate title fraud by recording ownership histories immutably and making them instantly verifiable by lenders and regulators. As a result, blockchain introduces a more efficient, inclusive, and secure ecosystem for both real estate investment and home financing, driving innovation in one of the world's most capital-intensive industries.

Credit Scoring and Lending: Enabling Inclusive and Trustworthy Finance through Blockchain

Credit scoring and lending are central components of the financial ecosystem, enabling individuals and businesses to access capital for consumption, investment, or expansion. However, traditional credit systems heavily rely on centralized data sources such as banks, credit bureaus, and financial institutions, which often exclude those without a formal financial history—commonly referred to as the "credit invisible." This results in limited access to loans, particularly for individuals in emerging markets, freelancers, gig workers, or small enterprises without conventional documentation. Moreover, centralized credit scoring models lack transparency, and consumers have limited visibility or control over their financial data. Blockchain technology presents a paradigm shift by enabling decentralized credit scoring systems that leverage alternative data, distributed identity management, and immutable records to offer a more inclusive, transparent, and secure credit evaluation framework. Blockchain-based platforms can aggregate and verify non-traditional data sources, such as mobile phone usage, utility payments, peer-to-peer transactions, and social reputations, into decentralized digital identities. These identities are owned and controlled by individuals who can selectively grant access to lenders for verification and scoring purposes, ensuring data privacy and user autonomy. Solutions like Bloom, Civic, and Kiva Protocol are already pioneering decentralized identity and credit scoring infrastructures. For instance, Kiva, in partnership with the government of Sierra Leone and supported by blockchain technology, developed a national digital identity system to help individuals build verifiable credit histories. In lending, blockchain can streamline the loan origination, underwriting, disbursement, and repayment processes by automating them through smart contracts. Peer-to-peer (P2P) lending platforms built on blockchain eliminate intermediaries, allowing borrowers and investors to interact directly, with repayment terms governed by coded logic. This approach lowers interest rates, increases efficiency, and enhances borrower-lender trust through transparent records. Furthermore, blockchain enables tokenization of loans, allowing their fractionalization and tradability, which enhances liquidity in credit markets. Overall, blockchain-based credit and lending systems democratize access to capital, reduce systemic bias, and create a more equitable financial landscape.

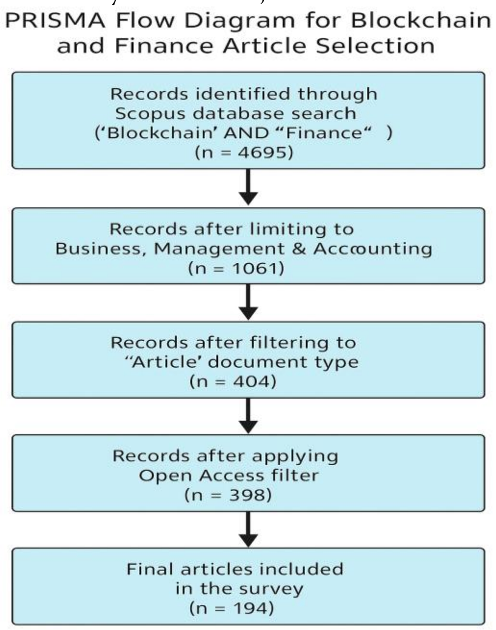

Fig-4: PRISMA Flow Diagram

Source: Author's Compilation

A systematic screening process was undertaken using the Scopus database to identify relevant literature on the intersection of blockchain and finance. The initial search using the keywords *"Blockchain"* AND *"Finance"* yielded a total of 4,695 documents spanning the period from 2014 to 2025. To enhance relevance, the results were first filtered by subject area, narrowing the scope to Business, Management, and Accounting, which reduced the dataset to 1,061 records. Further refinement to include only peer-reviewed journal articles brought the count down to 404. To ensure consistency in linguistic analysis, the selection was limited to English-language publications, resulting in 398 articles. Finally, restricting the dataset to open-access documents led to a final sample of 194 articles, which were thoroughly reviewed for this study. This structured filtration process, visualized through a PRISMA flow diagram, ensures that the final dataset is both methodologically sound and aligned with the research objective, offering a reliable foundation for synthesizing insights on the role of blockchain in financial applications.

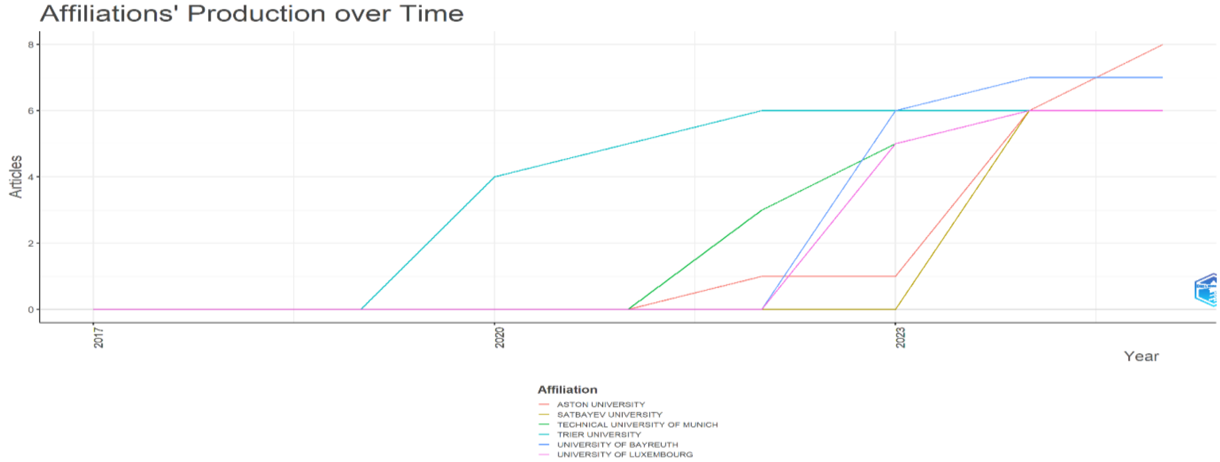

Fig 5: Institutional Contributions to Blockchain Research Over Time

Source: Generated using Biblioshiny (Bibliometrix R-package) based on Scopus database records

The figure illustrates the temporal evolution of research productivity across selected academic affiliations, measured by the number of published articles from 2017 to 2024. Notably, Trier University demonstrated an early and sustained increase in scholarly output beginning in 2020, reaching a plateau by 2022. In contrast, institutions such as Aston University and Satbayev University exhibited a late yet rapid surge in research contributions, with Aston University leading in total publications by 2024. The University of Luxembourg and Technical University of Munich also showed significant upward trends, suggesting a growing institutional emphasis on academic dissemination. These trajectories underscore varying research engagement strategies and capacity building efforts among the institutions over time.

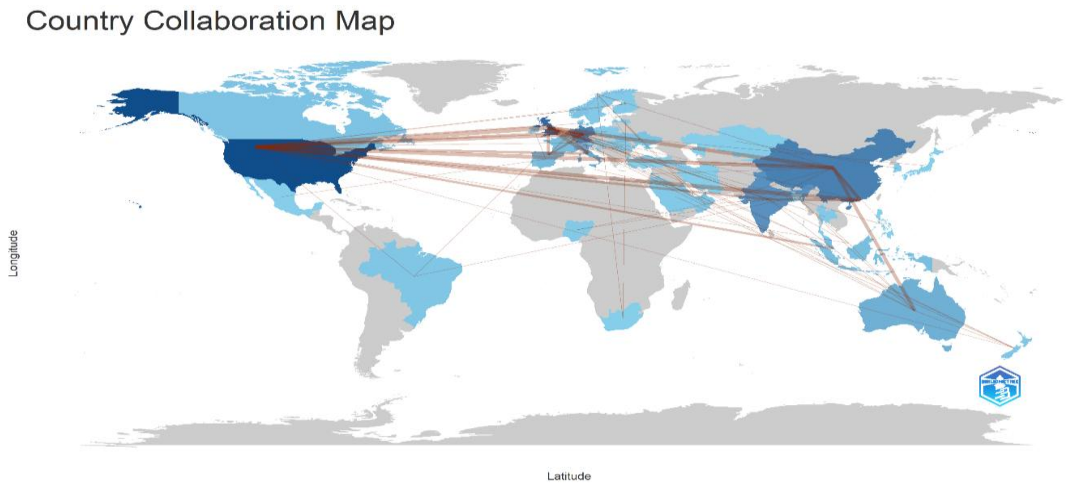

Fig 6: Geographic Distribution of International Research Collaborations

Source: Generated using Biblioshiny (Bibliometrix R-package) based on Scopus database records

The Country Collaboration Map visualizes the global research network by illustrating international co-authorship patterns across various countries. The map highlights significant transcontinental collaboration, particularly between the United States and several countries in Europe and Asia, indicating its central role in fostering global academic partnerships. Strong

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 4,2025
https://theaspd.com/index.php

linkages are also evident among European nations, as well as between Asian countries such as China, India, and South Korea. The intensity of collaboration, represented by the connecting lines and shading, underscores the growing interconnectedness of the global research landscape, where cross-border partnerships are critical for advancing multidisciplinary and high-impact scientific inquiry.

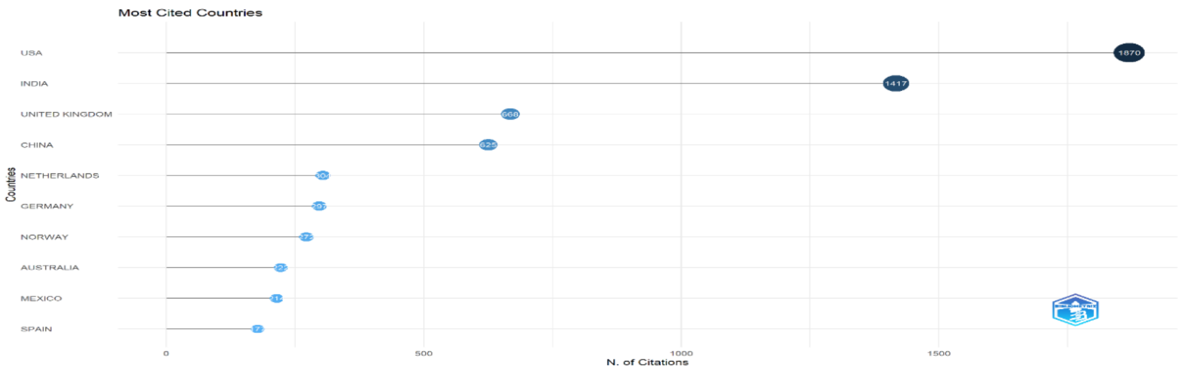

Fig 7: Citation Impact by Country in Blockchain and Financial Technology Research

Source: Generated using Biblioshiny (Bibliometrix R-package) based on Scopus database records

The figure titled *"Most Cited Countries"* presents a bibliometric analysis of citation frequency by country, revealing the global distribution of research impact. The United States leads with 1,870 citations, followed by India with 1,417, underscoring their dominant roles in scholarly influence and knowledge dissemination. The United Kingdom and China also demonstrate strong citation performance, with 668 and 529 citations respectively, indicating their significant contributions to global research output. Other European countries such as the Netherlands, Germany, and Norway appear in the mid-range, reflecting steady citation visibility. This citation landscape highlights the geographic concentration of high-impact research and suggests a strong correlation between national research ecosystems and international recognition.

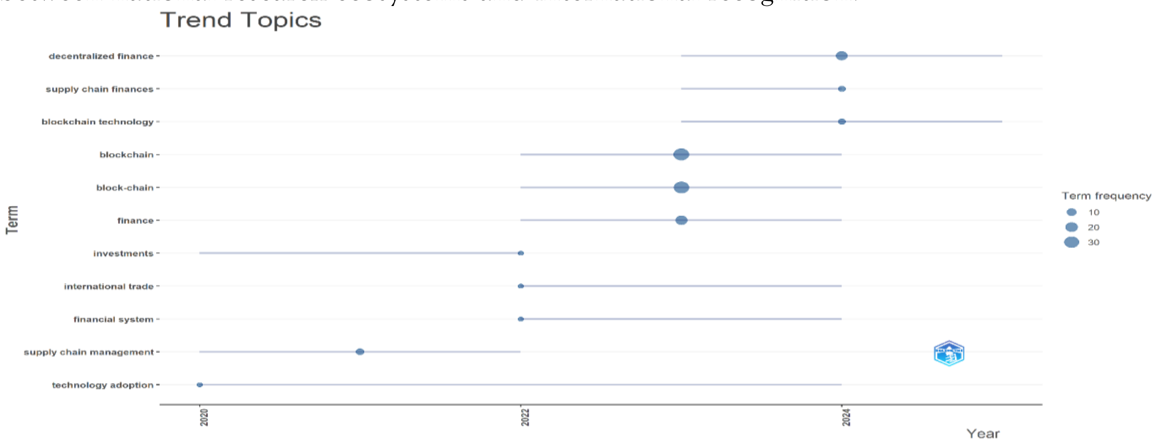

Fig 8: Emerging and Evolving Research Topics in Blockchain Finance

Source: Generated using Biblioshiny (Bibliometrix R-package) based on Scopus database records

The "Trend Topics" visualization provides a longitudinal analysis of thematic evolution in the research domain, highlighting the emergence and frequency of key terms over time. The figure reveals that from 2023 onward, there has been a significant surge in discourse surrounding decentralized finance, supply chain finances, and blockchain technology, indicating a growing scholarly focus on technological innovation in financial systems. Notably, the term "blockchain" itself demonstrates the highest frequency, emphasizing its centrality in current academic dialogue. Earlier years, particularly 2020 to 2022, show foundational interest in areas such as investments, supply chain management, and technology adoption, reflecting the initial conceptual grounding for later developments. This trend analysis underscores a paradigm shift toward digital transformation and decentralized systems within the research landscape.

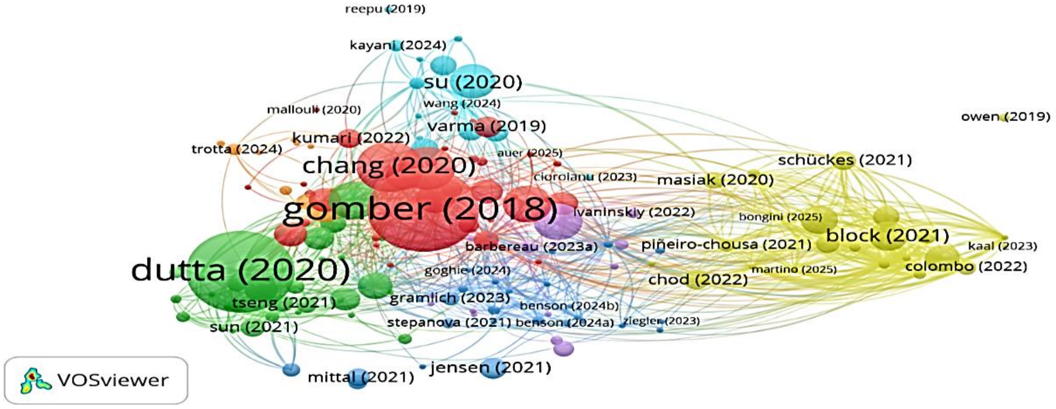

Fig 9: Author Co-Citation Analysis in Blockchain and Financial Innovation Literature

Source: Generated using VOS-viewer based on Scopus database records

The VOSviewer-generated co-citation network map visualizes the intellectual structure of the research field by clustering frequently cited authors based on citation link strength and thematic proximity. The largest node, Gomber (2018), occupies a central position, indicating its pivotal influence and high citation frequency within the domain. Surrounding clusters represent distinct yet interconnected research trajectories. For example, Dutta (2020) and Su (2020) lead prominent green and blue clusters respectively, suggesting their critical role in emerging subfields. The red cluster, centered around Chang (2020) and Kumari (2022), signifies collaborative knowledge development closely tied to Gomber's foundational work. Meanwhile, the yellow cluster, including Block (2021) and Colombo (2022), reflects more recent advancements, possibly in applied or technological contexts. The dense interlinkages among nodes demonstrate a high degree of scholarly interdependence, underscoring the evolving and interdisciplinary nature of the field. This bibliometric visualization offers valuable insights into citation dynamics, key contributors, and thematic cohesion across the literature.

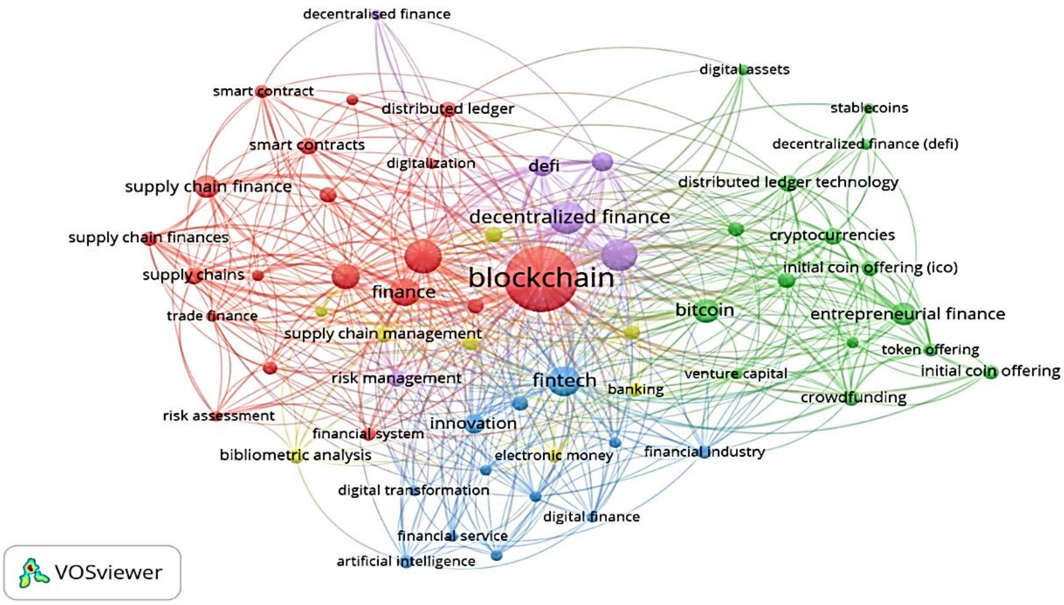

Fig 10: Keyword Co-Occurrence Network in Blockchain and Financial Research

Source: Generated using VOS-viewer based on Scopus database records

The co-occurrence network map generated by VOSviewer highlights the conceptual structure of the literature through keyword clustering, with "blockchain" emerging as the most dominant and central term, reflecting its pivotal role in current research. Surrounding clusters represent thematic groupings, such as finance, supply chain finance, and smart contracts (red cluster), as well as FinTech, digital transformation, and artificial intelligence (blue cluster), indicating interdisciplinary integration. The green cluster focuses on cryptocurrencies, initial coin offerings (ICOs), and entrepreneurial finance, capturing blockchain's application in alternative finance models. The purple cluster, centered around decentralized finance (DeFi), illustrates the growing importance of decentralized systems in reshaping traditional financial infrastructures. The dense interconnections among terms suggest a high degree of research convergence, with blockchain technology serving as a foundational element across domains such as supply chain, financial innovation, and digital assets. This map provides a comprehensive overview of emerging research fronts and the evolving landscape of blockchain-related scholarship.

CONCLUSION

This study offers a comprehensive review of blockchain's transformative role in reshaping traditional financial infrastructure by enhancing transparency, decentralization, and automation. Drawing insights from 194 peer-reviewed, open-access articles, it systematically explores the integration of blockchain across various financial domains, including capital raising, securities trading, investment management, and credit scoring. The findings underscore the disruptive potential of blockchain's foundational technologies—distributed ledgers, smart contracts, and cryptographic protocols—in addressing longstanding inefficiencies in centralized financial systems. Moreover, the study presents a bibliometric analysis revealing global research trends, institutional contributions, and thematic shifts in blockchain-enabled finance. Despite its promise, the practical implementation of blockchain remains constrained by scalability, regulatory ambiguity, and interoperability challenges. Future research should focus on empirically validating blockchain's impact across financial sectors, investigating the regulatory harmonization required for cross-border adoption, and exploring the convergence of blockchain with other digital technologies such as AI and IoT to build more resilient and inclusive financial ecosystems.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. No financial or personal relationships with other individuals or organizations have influenced the research findings, interpretation, or presentation of this study.

Acknowledgement

The authors express their sincere gratitude to the School of Management, Centurion University of Technology and Management, and KIIT Deemed to be University for their academic and infrastructural support throughout the course of this research. We also extend our appreciation to the Scopus database for enabling comprehensive access to high-quality scholarly articles, which formed the basis of our systematic review. Finally, we acknowledge the contributions of our peer reviewers for their valuable feedback in enhancing the quality and clarity of the manuscript.

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