Adoption of Blockchain Technology in Banking and Financial Services

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ABSTRACT

The origin of Blockchain Technology is crypto currencies, where initially this technology was used as a public ledger to record the transactions of crypto currencies. Beyond crypto currencies, Blockchain Technology has been considered to be worth utilising for various sectors like Banking, Financial services, supply chain management and healthcare management based on its promising features such as enhanced authenticity, security and risk management. This Technology with specific characteristics such as Decentralisation, Immutability and Transparency, and security has the potential to upgrade and transform the Banking and Finance sectors. The present research paper is focused on finding the Blockchain technology application areas in selected ten banks, review of literature is based on the views of the various authors on benefits derived by adopting Blockchain technology, a study on top four Blockchain technology platforms or frameworks along with their comparison.

Keywords: *Blockchain Technology; Banking and Financial services; Applications; Frameworks.*

1.0 Introduction

"Blockchain Technology" is disrupting financial sector by storm through its groundbreaking application initially by the crypto-currency - Bitcoin. Application of the Blockchain technology to date is followed by new digital applications such as Smart Contracts, have proven to be most promising innovations in financial sector. The Blockchain technology is growing very fast, increasing the workflow process in the financial industry.

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Paper currency is now outdated, digital interfaces are getting replaced by this new Blockchain Technology, which is considered as the most disruptive technology at present especially in the financial sector. There are multiple experiments on Blockchain implementation in developed countries and the use cases proved Blockchain quite successful in finance areas such as the capital markets, Asset management, insurance, banking and lending, payments and remittances and trade finance. Blockchain is a distributed, decentralized public ledger which records, and stores the information in blocks, validates and transmits the information to the parties concerned with a timestamp, Blockchain Technology has the ability to make digital transactions flow transparent, secured and cost-efficient while using this technology in digital payments, transactions can be executed without any intermediaries such as financial service provides, banks, clearinghouses. The Blockchain technology applications in the Banking and Financial services have proven to be of high performance based on its specific functional characteristics like, Security, Trust, Privacy, Programmability, and Scalability.

2.0 Objectives of the Study

1. Benefits of adopting Blockchain technology for banking and financial services.
2. Blockchain Technology application areas for Banking and Financial services.
3. Blockchain platforms/frameworks for Banking and financial services.
4. Comparison on the performance of the platforms/frameworks.

3.0 Review of Literature on the Application of Blockchain Technology in Banking and Financial Services

Banking operations: Research studies reveal immutability a specific feature of Blockchain technology, improves the accuracy, and smart contracts speedup the transactions and reduces financial frauds. Mukkamala *et al.* (2018) assert that by adopting Blockchain technology, participants could improve marketing and this technology application reduces barriers to entry in the marketing. Khan *et al.* (2020) observed Blockchain Technology reduces the need for reconciliation, helps to execute transaction in real time cut costs , lower the risk of data loss, helps in maintaining transparency Authors, Kumar *et al.* (2022)**,** revealed, blockchain technology is easy to understand each entry goes through peer-to-peer network by executing smart contracts the transaction gets verified and encrypted.

Financial services: Research studies by Pal *et al.* (2021) and Chen *et al.* (2020) reveal, financial services are developed using Blockchain Technology, many firms are investing in this technology which helps in storing huge volumes of financial transactions which are digitally signed, with a timestamp on each transaction. The features such as reduction of cost, increased speed of transactions, peer-to-peer transactions, Immutability, traceability of transactions, Blockchain is making disruption to the banking and financial services. Sanka *et al.* (2021). The specific features of Blockchain technology, such as immutability, transparency, trust, efficiency and security of transactions helps in reducing cost and saving transaction settlement time for the financial services providers. Gump & Leonard (2016) Gunasekera & Valenzuela (2020), Pal *et al.* (2021).

Table 1 shows a brief summary of blockchain applications in Banking and financial services reviewed by various authors.

Table 1: Review of Literature on the Benefits of Implementing Blockchain Technology in Banking and Financial Services

S.No.	Benefits	Description	Referred by
A	Maintains track of records	Blokchain helps in maintaining the record of transactions, with the help of automated transactions, security of banking and financial transactions will be improved. . By utilising this technology, Banking and financial services records millions of transactions, which are digitally verified, signed with a date tamp through network system.	Alam *et al.*, (2021); Friedlmaier *et al.* (2018); Idrees *et al.* (2021); Allen *et al.*, (2018); Yu *et al.* (2022); Nair & Bhagat (2020)
B	Increases transaction speed	Blockchain technology increases transaction processing speed, transactions are settled in least possible time, saves time and reduces cost.	Kokina *et al.* (2017); Ghosh (2021); Rao & Li (2022); Feng *et al.* (2022); Fu & Zhu (2019)
C	Facilitates security, transparency Confidentiality	Execution of Smart contracts automates workflows and improves privacy and confidentiality for the participants and provides immutable transaction record. Automated systems reduces cost and processing time of the transactions. Further, the adoption of this technology facilitates in digital identity for banks, KYC helps in reducing human mistakes.	Zhang & Han (2019); Ke & Tang (2022); O'Dair & Owen (2019); Haleem *et al.* (2021); Kurpjuweit *et al.* (2021); Zheng *et al.* (2020); Li (2019); Grover *et al.* (2019); Memon *et al.* (2018)
D	Traceability of data during transactions	Application of Blockchain technology facilitates traceability, assists Participants to track the transactions from anywhere, anytime.	Swan (2017); Petratos *et al.* (2020); Hooper & Holtbrügge (2020); Nasir *et al.* (2020)

E	Fraud prevention	Blockchain technology helps in fraud prevention through validation of transactions, with the help of specific feature of immutability, banks and financial services provide anti tampering transactions.	Kherbouche *et al.* (2022); Nurmukhametova *et al.* (2018); Kumar *et al.* (2020); Liu *et al.* (2021)
F	Banking and financial services	In banking and financial services, Blockchain technology eliminates intermediaries and makes peer to peer transactions possible, based on its unique feature of immutability, data privacy and security will be maintained, further, it helps in reducing financial risks.	Mukkamala *et al.* (2018); Wang *et al.* (2017); Khan *et al.* (2020); Hong (2021); Klarin (2020); Kumar *et al.* (2022); Chen *et al.* (2020); Sivaram *et al.* (2020); Pal *et al.* (2021); Alao & Cuffe (2020)
G	KYC	Blockchain technology allows participants to access information about their transactions, Banks are exploring significant application of Blockchain technology based IDs in making the tamper proof secured, immutable digital identity of the clients.	Zhang *et al.* (2020); Woodside *et al.* (2017); Su & Wang (2020); Boughaci & Alkhawaldeh (2020)
H	Minimises transaction cost and processing time	Blockchain adoption in banking and financial services leads to improve service quality, helps in reducing cost. Peer to peer transaction system reduces settlement ,clearing and processing time and also, helps in reconciliation process of auditing	Kim *et al.* (2020); Cai (2021); Antoniadis *et al.* (2020); Yu *et al.* (2022); Luo & Tang (2022); Baiod *et al.* (2021); Maulani *et al.* (2021); Ahram *et al.* (2017); Salisbury & Khvatsky (2018); Janaviciene & Fomin (2019)
I	Stores financial and non-financial transactions.	Blockchain technology can also be used to securely store financial transactions. This technology can be used for financial and non-financial transactions, for instance, it can be used in hospitals to record a patient's medical history. It can also be used to store e-books, sports and music.	Gao & Chen (2021); Batwa & Norrman (2020); Zhang (2022); Dos Santos *et al.*, (2022); Gurtu & Johny (2019)
J	Transparent money transactions	Blockchain technology allows people to transfer and receive money without any intermediaries. In financial dealings, Blockchain technology enables direct contact between lenders and borrowers and helps them to negotiate interest rates, repayment terms and so on by executing smart contracts. The information in the ledger within each block are immutable, denies access to hackers and reduces the chances of fraud.	Yu *et al.* (2018); Puthal *et al.* (2018); Tezel *et al.* (2020); Sujatha *et al.* (2022)

Source: Prepared by authors

4.0 Adoption of Blockchain Technology in Different Functional Areas in the Banks

The Blockchain technology applications in the Banking and Financial services have proven to be of high performance based on its specific functional characteristics like, peer to peer transactions, transparency, Immutability etc., In banking functional

areas, Blockchain has been widely used.JP Morgan, Citi bank, Bank of America, Common wealth Bank, DBS, PNB Paribas, JP Morgan along with 300 banks are now in the consortium using Quorum's Blockchain network called by Interbank Information Network (IIN), major objective of the IIN is for the banks to reduce problems, delays and frictions in the global payments to reach the beneficiaries in reasonably less time. Top ten banks utilising Blockchain technology for various applications are mentioned in the Table 2.

Table 2: Top 10 Banks Utilising Blockchain in Various Functional Areas

Banks	Purpose
JP Morgan	JP Morgan has used Blockchain in multiple countries including India and USA for a variety of purposes • In June 2013, JP Morgan launched a Blockchain pilot project in Gujarat International Finance Tec–city (GIFT City) to settle interbank US dollar transactions, the project was a collaboration with six Indian banks, including Axis bank, HDFC bank, ICICI bank, Indus land Bank and Yes bank.
Common wealth bank	The Commonwealth bank of Australia (CBA) has used Blockchain in Australia for the following purpose: • To allow customers to hold and use crypto on its app. CBA is an Australian multinational bank with operations in New Zealand, Asia the United States and the United Kingdom
BNP Paribus	BNP Paribas deals with securities services utilising Blockchain platform. • The move follows the French government's initiative to allow private stocks and help private companies to issue mini bonds via crowd funding platforms. The bank is working in partnership with renewable energy crowd funding specialists Lend sphere, Enerfip and Lumo on this initiative.
Bank of America	Bank of America is a prominent investor in blockchain technology and has been using it in a number of ways including: • *Stock settlements:* B of A uses the Paxos Settlement service to reduce the time it takes to settle stock trades. This collaboration with Paxos allows B of A to settle trades in minutes instead of days • *Global Digital disbursements:* This service allows business and consumers to make payments using a mobile identifier or email address • *Blockchain Patents:* B of A has hundreds of blockchain patents and in Q12024, it had 56 patents focused on improving security, efficiency, and reliability. • *Digital assets:* B of A launched Global Research to cover digital assets • *Predictions about blockchain:* B of A predicts that blockchain infrastructure

	could reshape how value is stored and exchanged across industries. B of A is also investing in AI and other technologies to maintain its competitive edge in the financial services industry.
Deutsche Bank	Deutshe bank is involved in blockchain use in India and globally in several ways including: • Digital fund management: Deutshe bank and Memento blockchain completed a proof of concept called project DAMA which aims to simplify the process of launching and accessing digital assets. • DLT payment infrastructure: Deutshe bank invested in Partior, a DLT payment infrastructure that could potentially support the Indian rupee. • India growth strategy: Deutshe bank has increased its capital allocation in India to support its expansion in the country. • Blockchain interoperability: Deutshe bank collaborated with other financial institutions and Web 3 innovators to produce a paper on how to achieve interoperability for tokenized assets across blockchains and legacy systems. The paper describes how financial institutions can increase accessibility and liquidity for tokenized assets.
DBS	DBS uses blockchain in the following ways: • *DBS token services:* A suite of services that used blockchain and smart contracts to enable real-time payments, programmability, and enhanced security. • *DBS Digital Exchange:* A bank-backed exchange that provides access to digital currencies and security tokens. • *Paritor:* A joint venture with Temasek and JP Morgan that provides a platform for real-time payments, clearing and settlements. • *API Solutions:* DBS uses blockchain technology to improve AP solutions for corporate clients, such as digitising trade processes and bridging supply chain liquidity gaps. • *Project Orchid and project Guardian:* DBS has participated in these blockchain pilot projects led by Monitory authority of Singapore. (MAS) • *Treasury Tokens:* A product that uses blockchain technology and smart contracts to deliver banking services on a 24/7 basis.
Standard chartered Bank	Standard chartered bank utilises Blockchain for cross border transactions between Hong Kong and Singapore for the following purposes: • Reduce clearing & settlement times • Enhance client transparency and liquidity in transactions • Tokenize the traditional financial instruments.
Citibank	Citibank uses Blockchain to advance trade digitalization and enhance client experience.

	• Letter of Credit (LC) transaction: In April 2023 Citi bank completed its first blockchain-enabled LC transaction on the Contour platform in India proved the following: (a) Faster processing: The transaction was completed in three hours compared to the five to ten days that document presentation usually takes. (b) More secured payment: Digital documents were electronically signed, making them harder to forge. (c) Collaboration: The platform allowed multiple parties to collaborate in real-time. • Digital custodian for BondbloX: Citibank became the first digital custodian for Bondblox which plans to use blockchain for tokenized deposits. • Digital assets capabilities: Digital money, Trade, Securities, Custody, Asset servicing Collateral mobility
OCBC Bank	OCBC Bank is using blockchain technology in a number of ways including: • Cross-border fund settlements: OCBC is collaborating with Ant International to develop tokenized deposits that will enable real-time cross border payments between Singapore and Malaysia • Conditional payments: OCBC has integrated a blockchain based conditional payments solution with its business banking platform. This solution allows the Land Transport Authority of Singapore (LTA) to disburse mobilisation advance payments to contractors more efficiently and transparently. • Institutional intraday lending: OCBC is using blockchain technology to enable faster and more resilient financial transactions.
Santander	Santander uses blockchain technology in a variety of ways including: • Payments: Santander's blockchain lab is developing payment solutions for individuals, especially in areas with limited traditional payment infrastructure. • Smart contracts: Santander offers services based on blockchain's smart contracts capability through its participation in the Trade consortium and help banks • Digital identity verification: Blockchain helps banks verify customer identities quickly and accurately, reducing fraud risk and ensuring compliance with KYC regulations. • Capital market innovations: Santander launched the first end –to -end blockchain bond, demonstrating to clients that it is a leader in capital markets innovation. Blockchain is a distributed ledger or a database that maintains a growing list of records linked using cryptography.

Source: Websites of the banks

5.0 Blockchain Platforms /Frameworks for Banking and Financial Services

Hyper ledger fabric: Hyper ledger Fabric is one of the projects of hyper ledger, intended for building Blockchain based solutions or applications using a modular architecture, it is a permissioned network hence authorises participants within the system to carry out transactions. Digital asset and IBM initiated this hyper ledger platform for providing enterprise solutions. Nasir *et al.* (2018)

Ethereum: Ethereum, an open source, public Blockchain platform was founded and proposed by Vitalk Buterin, a 22-year-old, Russian, Canadian computer programmer in the year, 2013.It is a POW (Proof-of-work) based platform, Ether is a native crypto currency of Ethereum, which is used for fuelling the Ethereum ecosystem. As per the system, a developer who builds applications using Ethereum has to pay relevant charges in crypto currency, Ethers, for executing the transactions and running apps on the Ethereum network. Smart contracts are enabled and executed using Blockchain Ethereum Virtual Machine (EVM), every node within the network runs on EVM implementation Rouhani & Deters (2017).

R3 Corda: R3 Corda consortium of world's leading financial institutions is an open source, permissioned Blockchain platform, which allows the authorised participants to access the data founded in the year, 2015. The institutions within the consortium, transacts directly, with the help of smart contracts, which helps in reduction of costs and time of execution of transactions. Initially it was designed for financial services, but now R3 Corda is being applied in Capital markets, Digital assets, digital identity, Supply chain, Healthcare, Insurance, Real estate, Land registry, Tele communications, Trade finance. Consortium has more than 60 firms, including Intel and Microsoft, using Corda as a Blockchain platform. Major participants like HSBC, Intel, Bank of America Merill Lynch, and dozens of other institutions have invested around $107 million into R3 Corda.

Quorum: Quorum is a private and permissioned Blockchain platform, developed and maintained by J.P. Morgan, Quorum is an open-source Blockchain platform, designed to be permissioned, the networks using Quorum won't be open to everyone. It is built to addresses specific challenges to Blockchain adoption within an enterprise environment including as privacy, speed, and throughput (Baliga *et al.*, 2018).

6.0 Comparison of Blockchain Platforms

A brief comparison on the characteristics and performing ability of major four platforms of Blockchain technology in banking and financial services is provided in the Table 3.

Table 3: Comparison on Characteristics of Blockchain Platforms

Characteristics	Ethereum	Hyper ledger Fabric	R3 Corda	Quorum
Application areas	Cross - Industry	Cross - Industry	Financial Services	Cross - Industry
Smart contracts	Solidity	Go, Java	Kotlin	Solidity
Governance	Distributed among participants	Linux Foundation	R3 Consortium	Ethereum developers and JP Morgan Chase
Privacy	Existing Privacy	Not prevalent	Not prevalent	Not prevalent
Currency	Ether	None	None	None
Consensus mechanism.	Requires acceptance by all nodes	By the parties directly involved	Only parties involved in the transactions.	Only parties involved in the transactions.
Operation mode	Public	Private	Private	Private
Transaction per second	Ethereum 2.0: 100,000 transactions per second	More than 2,000 transactions per second	Approximately 550 transactions per second	Approximately 600 transactions per second

Source: Prepared by the authors

7.0 Conclusion

The implementation of Blockchain has proved to be successful in banking and finance system by facilitating a new way of payment using the frameworks such as Hyper ledger Fabric, Ethereum, R3 Corda, and Quorum from JP Morgan. Banking Financial services need to be controlled, regulated by centralised authority, hence, banking and financial institutions are forming Blockchain consortium. Various studies reveal, adoption of Blockchain technology helps in executing transactions in the least possible time and reducing cost significantly. An attempt has been made to bring out major benefits of adopting Blockchain platforms such as hyper ledger, Ethereum, Quorum and R3 Corda, in banking and financial services, but it requires still further study on the topic.

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