BenchCouncil Transactions on Benchmarks, Standards and Evaluations 2 (2022) 100073

Contents lists available at ScienceDirect

BenchCouncil Transactions on Benchmarks, Standards and Evaluations

journal homepage: www.keaipublishing.com/en/journals/benchcouncil-transactions-on-benchmarks-standards-and-evaluations/

Review article

A review of Blockchain Technology applications for financial services

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ARTICLE INFO

Keywords:
Blockchain
Finance
Customer
Banking
Transaction

ABSTRACT

Financial service providers find blockchain technology useful to enhance authenticity, security, and risk management. Several institutions are adopting blockchain in trade and finance systems to build smart contracts between participants, improve efficiency and transparency, and open up newer revenue opportunities. Blockchain's unique recording capabilities make the existing clearing and settlement process redundant. Banks and other financial entities are adopting blockchain-enabled IDs to identify people. Better results come from organisations' capacity to foresee emerging trends in financial blockchain applications and develop blockchain functionality. The transfer of asset ownership and addressing the maintenance of a precise financial ledger. Measurement, communication, and analysis of financial information are three significant areas to be focussed on by accounting professionals. Blockchain clarifies asset ownership and the existence of obligations for accountants, and it has the potential to improve productivity. This paper identifies and studies relevant articles related to blockchain for finance. This paper focuses on Blockchain technology and its importance for financial services. Further takes up various tools, strategies, and featured services in Blockchain-based financial services. Finally, the paper identifies and evaluates the significant applications of Blockchain technology in financial services. Credit reports significantly impact the financial lives of customers. Recent data breaches demonstrate the superior security of blockchain-based credit reporting over conventional server-based reporting. Blockchain-based systems enable the faster, more cost-effective, and more customised issuance of digital securities. With its adoption, the market for investors can be expanded, costs for issuers can be reduced, and counterparty risk can be reduced due to the ability to customise digital financial instruments to the demands of investors. It uses mutualised standards, protocols, and shared procedures to give network users a single common source of truth. Participants in the business network can now more easily collaborate, manage data, and agree with this technology's application.

1. Introduction

Blockchain offers a decentralised system in which users can update the blockchain network. Blockchain networks are devoid of interference from financial institutions. Information can be stored on blockchains, and the digital ledger system facilitates information sharing. It can be utilised to communicate information with network users directly. A secure network for performing transactions is provided by Blockchain. Because of its robust security mechanism, blockchain technology appeals to various businesses. Each company's accounting functions are now carried out independently, and the data reconciliation process requires time and personnel [1–3]. Blockchain technology can address this issue by allowing for the real-time recording of transactional, contractual, and other information in a shared ledger. It implies that automatic verification of legal compliance will take place. The effectiveness of the organisation's operations will be significantly increased. The consumer experience might be enhanced, making data transactions and identities more secure. Blockchain is based on a distributed ledger concept that logs every transaction and maintains the timeline and veracity of that information on a secure, tamper-proof worldwide network [4,5].

As the digital revolution advances, this technology can help to maintain the balance between technology, user data, and privacy. The emphasis on confidentiality may increase while data management may also benefit. The audit process is more transparent and faster when accounting documents between counterparties are trustworthy and current. Auditor attention might be focused on more complicated and divisive problems rather than reviewing many everyday

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https://doi.org/10.1016/j.tbench.2022.100073
Received 29 September 2022; Received in revised form 17 October 2022; Accepted 17 October 2022
Available online 22 October 2022

transactions. As a result, neither auditors nor accountants were eliminated due to process automation [5,6]. Artificial intelligence and Blockchain are two very different technologies with exceptionally diverse applications. Contrarily, artificial intelligence relies on secure data that cannot be accessed or replicated and is a highly centralised service. Numerous advantages stem from their collaboration, especially in financial assistance. Blockchain technology allows for seamless communication between the parties involved in transactions, eliminating the need for recordkeeping in the order-to-cash, record-to-report, and procure-to-pay processes [7–9].

Smart contracts enabled by blockchain technology can help all parties create legally binding financial agreements that they will execute with a guarantee once all prerequisites have been satisfied. Like traditional contracts, smart contracts enforce the terms in real-time and without ambiguity on a blockchain, cutting out the intermediary and enhancing responsibility for all parties in ways regular contracts cannot [10–12]. Since a decentralised network of computers handles intermediary duties through the internet, the distributed ledger solution does not require a reliable third party. Every transaction is documented in a digital ledger, disseminated to every network member, and publicly available. The network can confirm asset ownership and transparent transactions since each network member has a legitimate copy of the ledger, making it a more secure mechanism than the existing central ledger approach [13–15].

Digital technology has created new opportunities for increased collaboration. Financial accounting procedures have been altered by cloud-based applications with analytics specialised for particular use cases such as account payables and receivables, contract administration, reporting, and others. The safest forms of payment are cash, cashier's checks, and wire transfers. However cannot tacks wire transfers, which take time, and cash. Payments made using blockchain technology do away with these problems and increase customer confidence. Technology makes real-time cash transfers between financial institutions possible, lowering friction and expediting settlement. This technology offers the potential for automation and is ideal for tracking transactions. Financial service providers can use smart contracts to monitor buyer payments and seller deliverables [16–19]. This article discusses blockchain technology, its need, tools, features and significant applications of Blockchain for finance services.

The remaining paper is structured into ten sections. Section 2 develops the understanding of blockchain, whereas Section 3 highlights the importance of blockchain in finance; Section 4 outlines the research objectives. Section 5 highlights strategies in blockchain for financial services, Section 6 discusses the Services of Blockchain Technology in the Financial area, and Section 8 provides the potential applications of blockchain in finance. Section 9 addresses the limitation of the study, Section 10 provides the future scope of the study, and the last Section 11 concludes the study.

2. Blockchain

A blockchain comprises of blocks, chains, nodes, and master nodes. Nodes are in-charge of the network's blocks. Adding blocks to the Blockchain is a challenging operation requiring mathematical problem-solving. The blockchain network's capacity to expand endlessly is constrained by the task of solving challenging mathematical puzzles. Hacking, cheating, or otherwise altering the blockchain network is virtually impossible due to the uniqueness of hash codes. Blockchain is a distributed ledger in which a copy of the ledger is kept on each connected computer. The network is called the Blockchain because it consists of interconnected blocks serving transaction records. The idea and functioning of cryptocurrencies depend on the blockchain network [20–22].

A blockchain is a digital transactional ledger. Its structure, in which separate data, known as blocks, are connected in a single list known as a chain, gives rise to the name. Blockchains have numerous uses besides keeping track of monetary transactions like those involving Bitcoin. A blockchain manages and stores data, making it hard or impossible to alter, hack, or defraud the network [23,24]. A blockchain is a network of computer systems that duplicates and distributes copies of a digital transaction record. Modern technology has long been employed in the financial industry to guarantee data and process security. Blockchain has already gained popularity in the banking sector. Blockchains allow for the safe, dependable, and verifiable conduct of financial transactions, as demonstrated by the emergence of cryptocurrencies [25,26].

Blockchain is a digital database that enables simultaneous storage of certain operation records across numerous machines. Digital data on transactions, contracts, and contact databases are stored using this technology as a series of interconnected blocks. The absence of transparent and unambiguous financial system regulations exposes the business to common mistakes and inaccurate information interpretation [27,28]. Blockchain technology addresses the majority of these problems and dramatically lowers financial risk. The importance of Blockchain technology is becoming more widely known. It is surrounded by a small number of people trying to figure out how to adopt and use this technology's advantages in their companies. The main goal of founding banks was to unite the population and make it possible for them to engage safely and efficiently through trade and commerce. A creation that makes it easier to complete various activities on a global scale is the blockchain platform [29–31].

3. Need of blockchain

The global financial system provides services to billions of people daily while managing trillions of cash. Such ambitious objectives come with several difficulties that the finance sector has been coping with for a long time. These issues include the expenditure of having numerous stakeholders, delays, extra paperwork, and data breaches, resulting in enormous losses the business endures each year. The issues facing the global financial system may be resolved by blockchain technology [32,33]. In addition, the cost of the current stock market is increased by the presence of organisations like regulators, brokers, and the stock exchange. System effectiveness can be increased by using a decentralised management strategy for stock exchanges. There is no need for external regulators because smart contracts can be created on Blockchain. Equity markets are getting ready to decentralise as a result. Blockchain technology makes it possible to conduct every type of investor-company interaction securely and without intermediaries, lowering expenses [34–36].

The financial sector has suffered several difficulties for a very long time. Numerous issues have been solved due to tremendous technological advances, yet some innovations have brought forth new issues. Since so many fintech options are available today, it can be challenging for financial service providers to choose the one that would work best for them. As a result, they look for a comprehensive solution that can handle all the pressing problems. The use of Blockchain for financial services is quite exciting and has the potential to address substantial business issues [37–39]. Due to centralisation, the financial industry must spread a considerable sum of money over numerous businesses. Financial service providers must invest in accounting, database upkeep, central database procurement, value transfer systems, database security, labour costs, and commissions for intermediaries. Financial service providers also need to budget for each of these assets regularly because they are all recurrent. A financial service system can become expensive due to all the additional expenses [40,41].

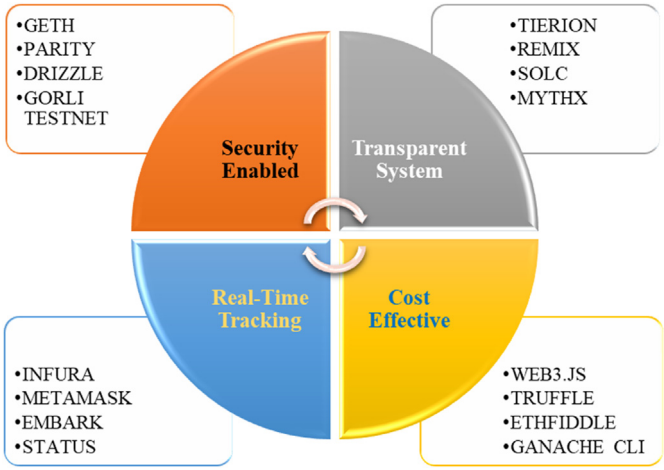

Fig. 1. Several tools and methods in blockchain for financial domain.

4. Research objectives

Blockchain-based technologies may potentially aid in the development of capital markets. Traditional trade financing techniques have long been a source of annoyance for firms, as the lengthy processes frequently disrupt operations and make liquidity challenging to manage. Blockchain can ease cross-border operations and streamline trade finance transactions. It facilitates business transactions beyond regional or geographic boundaries in a secure manner. Blockchain is particularly suited to tasks like real-time tracking commodities as they move and change hands across the supply chain due to its immutable record. Using a blockchain gives businesses that deliver various items and possibilities. Events in a supply chain, such as allocating arriving items to different shipping containers, can be queued up using entries on a blockchain. A novel and flexible method of organising and utilising tracking data are provided by blockchain technology [42–45]. The primary research objectives of this paper are as under:

RO1: - to brief about Blockchain technology and its need for financial service;

RO2: - to discuss the tools and strategies in Blockchain for financial services;

RO3: - to study the various featured services of blockchain technology in the financial domain;

RO4: - to identify and study the significant applications of Blockchain technology in finance service.

5. Tools and strategies in blockchain for financial services

Several featured tools and methods have been observed in the broad domain of blockchain technology for financial services and its structure. Fig. 1 reflects the various tools and strategies in blockchain applications for financial services, found impressive over time. These methods and tools are pretty smart and practical for handling real-time financial issues through the concepts of Blockchain. The highlighted soft tools are parity, geth, solc, mtyhx, truffle, infura, metamask, etc. These smart and advanced tools further ensure the future of blockchain practices towards strengthening financial services and their domains [46–48].

The financial services industry has speculated about Blockchain's possibilities for the last ten years. Blockchain is essentially a ledger of recorded financial transactions. Several locations disseminate, publish, and store this ledger. When a transaction occurs, it is recorded in each ledger copy through block creation. This helps to ensure that transactions are accurately recorded [49,50]. Blockchain is practically unchangeable and incredibly secure because there are multiple copies of the ledger; to alter or falsify any section of the record, a hacker would have to alter every copy of the ledger simultaneously, which is exceedingly challenging to do. Blockchain promotes confidence among commercial partners and allows for safe, straightforward transactions. It makes creating and using deterministic smart contracts tamper-proof programmes that automate business logic, boost efficiency, and promote trust. At every stage of the software stack, it provides market-leading technologies for granular data privacy, enabling selective data sharing in corporate networks [51–53].

Compared to regular securities, digital securities can be issued faster and more efficiently. Customised digital financial instruments can be created by issuers and directly matched to investor demand. These are fractionalised ownership of real-world assets, tokenised micro-economies, safe, scalable, and rapid asset transfers, and more. Due to these benefits, governance systems are more transparent and accountable, businesses are run more effectively, and stakeholder incentives are better aligned [54–56]. Venture capital, private equity, real estate funds, and specialist markets are under pressure to strengthen liability risk management, implement more dynamic decision-making frameworks, and address the increasing complexity of ever-changing rules. Blockchain can enhance stakeholder and asset management greatly. Blockchain applications in finance are among the most promising because digital currencies were the first thing to be stored on them [57,58].

For instance, smart contracts might be used by an insurance firm to speed up the claim's procedure. The codes built into the Blockchain will automatically assess claims when a client submits one. The smart contract will be carried out, and the client will be compensated if it is valid. Most financial institutions demand that their clients undergo an identity verification process to prevent fraud and money laundering. A digital ledger is produced when a new block is created for each transaction and added to the chain [59–61]. The potential for blockchain use in finance has increased with the significant benefits of blockchain ledgers over conventional digital ledgers. A distributed digital ledger can be created using blockchain technology. As a result, processing and storing transaction data are not needed by a single third party. Due to the absence of a centralised repository for keeping transaction data with a unique security mechanism, using Blockchain can eliminate the potential of transaction data hacking [62,63].

Blockchain applications in banking may be easier to use and less expensive. Security with blockchain technology is among the many aspects that encourage using this technology in banking. Blockchain secures its transaction ledger via encryption. As a result, the data was only accessible to those with a unique key code. Many different fintech solutions are currently available in the financial sector. As a result, financial service providers typically struggle to find the correct answer to their problems. Blockchain applications in finance can help solve some of the industry's biggest problems [64–66]. All around the world, financial services are still run in a conventional, centralised, and multi-layered fashion. Most financial data is kept in centralised systems and must go via several intermediaries, and transparency is compromised. Furthermore, database security and intermediaries are the only factors that affect data security. On the other hand, even databases with the highest levels of security are susceptible to hacking and data breaches. Because no one is aware of any disparities until a data breach or other system error is found, a lack of transparency usually results in complex security issues [67–70].

Policymakers might support the creation of teaching materials on blockchain technology. Users might be able to avoid frequent blockchain frauds, and businesses might find additional capacity to deploy the technology. Policymakers may use blockchain technology to accomplish their own unique goals. This could help organisations in public, and private sectors decide whether the technology can help solve particular issues [71,72]. Organisations attempting to integrate blockchain technology with their current systems may find this to be more accessible as a result. Based on blockchain technology, policymakers could explain current laws and regulations or create new ones.

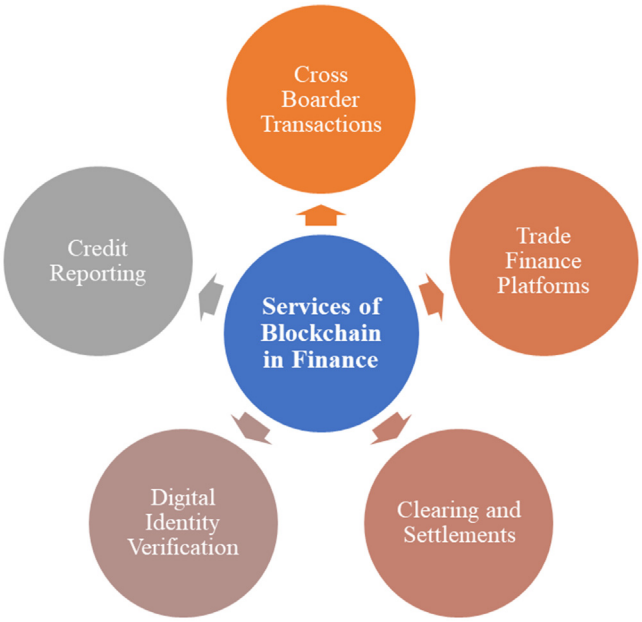

Fig. 2. Specific and typical services of blockchain in financial sectors.

This would lessen the ambiguity surrounding the potential regulation of various technological implementations, increasing the comfort level of businesses and others in embracing blockchain solutions [73–75].

Blockchain applications use two types of security keys: private and public keys. All network users have access to the public key, but only the participants in a transaction can access the private key. As a result, users inside a network can see the transaction, while participants can only access the transaction's specifics. Blockchain can preserve financial system transparency while safeguarding the private financial data of transaction stakeholders [76,77]. Nearly every industry in the world could experience a fundamental shift in how business is conducted due to blockchain technology. As the technology and its use cases develop and advance, Blockchain enables businesses to create better transparency, traceability, and operational efficiency for various business transactions and contracts. Financial institutions are looking at ways to use Blockchain to its full potential, including identifying product opportunities, resolving regulatory issues, and overcoming challenges in recognising/assessing risks and corresponding controls [78–80].

6. Various featured services of blockchain technology in the financial domain

Apart from the various developments and advancements made in the scope of blockchain practices for the finance sector, there are several featured services, too, for making financial services impactful in real-time applications. Fig. 2 exemplifies the several featured services, such as; cross-border financial transactions, trade finance platforms, proper reporting of credits, clearing and settlements, and digital identity verification. These featured services and developments in the blockchain sector will offer a capable blockchain-based financial sector [81–83].

Authorities in the financial sector and Blockchain specialists claim that by bringing visibility and reducing friction along the lengthy list of transactions that typically precede financial interactions, Blockchain is enhancing security, reducing risk, and saving money. These blockchain benefits save financial institutions expenses to some extent. Financial institutions have typically acted as a bridge between different parties, involving labour-intensive, complicated processes that slow down transactions [84,85]. Given the immutability of Blockchain, it is simple to understand why the technology is perfect for financial applications since it allows for safe, simple transactions and promotes trust between participants. Technology can automate and optimise services while lowering fraud, so even banks stand to gain significantly. Through Blockchain, a financial institution can secure identity information, and financial institutions can boost consumer confidence while preventing fraud and accelerating the verification process [86–88].

Blockchain technology is a tamper-proof log of sensitive activities that are efficiently and securely created. Therefore, it is perfect for money transfers and international payments. One can automate the entire procedure on the Blockchain, increasing the process efficiency while reducing the number of intermediaries traditionally needed in these transactions. Blockchain technology can lower the cost of payments by removing the requirement for banks to settle transactions [89,90]. The majority of regulatory supervision relies on recordkeeping, but there is no disputing that the repercussions of not maintaining records are much harsher. As a result, firms cannot compromise on compliance. By using Blockchain, regulators and corporations may access real-time record updates, reducing delays and making it easier to spot irregularities. Blockchain's central encryption is particularly beneficial for record administration because it eliminates duplication, fraudulent entries, and other issues [91–93].

Additionally, when banks collaborate on a Blockchain, the overall costs of the Blockchain and its supporting ecosystem could be higher than the separate costs associated with handling transactions at a particular bank. However, there is a significant cost decrease because the expenditures are split among all participating institutions. Because smart contracts automatically execute after specific pre-established conditions are satisfied, they increase contractual term performance when utilised by banks and other financial organisations [94–96]. These smart contracts must be solidly grounded in the law and adhere to all applicable regulations, including cross-jurisdictional compliances if necessary. Blockchain can be helpful in complex financial asset transfers controlled by an unchangeable set of business rules that can automatical certain types of disputes. Peer-to-peer transactions are made possible by Blockchain, which is one of its main advantages because it does away with the necessity for a reliable middleman. Blockchain technology may make obsolete fee-charging intermediaries like custodian banks and clearers in the financial services sector. Blockchain offers excellent capital optimisation because banks' operational costs have been significantly reduced [97,98].

Blockchain transactions are currently automatable and programmable. These fundamental components set the stage for the financial services industry to achieve preferred-of levels of efficiency, transparency, and security. The capital market, which allows for trading financial securities like shares and bonds, is used by businesses to raise money and might be significantly impacted by Blockchain. This technology is feasible to issue and exchange assets quickly and do so for less money, and the new blockchain technology makes no middlemen. The ability to more fully customise blockchain technology [99–101]. Substituting streamlined, automated processes with laborious, paper-based ones has the potential to boost trade efficiency. A public blockchain can be a fantastic tool for collaboration because it is decentralised and cannot be held by one single entity. Bank transactions may be settled directly and tracked more efficiently with a distributed ledger technology like Blockchain than current methods [102,103].

High-tech securities are replacing conventional securities in the banking sector. By simulating recent asset transactions on the Blockchain, the business has started to test the Blockchain. However, there is still some room for the success of the blockchain solution. One of the most important advantages of Blockchain is the history of unchangeable transactions. This will help to lower the number of crimes against financial institutions. Smart contracts have been made possible by using blockchain technology. Agreements based on tamper-proof algorithmic executions and decentralised consensus are known as smart contracts. A group of digital agreements contains the terms and conditions pledged by contract participants. With its programmable

protocol, the smart contract makes it possible to execute and automate contract terms [104–106].

Smart contracts can save costs for information gathering and processing, contract formulation and negotiation, agreement monitoring & enforcement, and relationship management, sometimes enabling more market-based governance structures. Due to the safe storage system and assurance that actions are carried out automatically without human error or the involvement of intermediaries in the payment process, smart contracts generally have the potential to boost data trust [107–109]. Smart contracts can potentially improve open account trading parties' confidence, promote trade transaction transparency, ensure data veracity, lower the risk of errors or fraud, and simplify the exchange of payments. Blockchain applications go beyond Bitcoin and other cryptocurrencies. Any transaction or ownership information, including tangible assets (like real estate) and intangible assets (like intellectual property), can be recorded and tracked using blockchain technology. Additionally, it may automate contracts, making creating and carrying them out much simpler [110,111].

7. Blockchain technology applications in finance service

Blockchain technology shows potential applications for financial services. Transaction fees, which traditional financial institutions profit from, could be reduced or eliminated by blockchain technology. Consumers must rely on banks or outside organisations to conduct transactions involving money transfers. The implementation of blockchain technology may avoid intermediaries like banks, thereby removing fees and other expenses related to these services [112,113]. As a result, banks can experience problems with volume and transaction-based revenue. It makes it possible for private and public chains to communicate. By enabling previously unheard-of degrees of connectedness and programmability among goods, services, assets, and holdings, the digitisation of financial instruments, which includes digital assets, smart contracts, and programmable money, extends the advantages of blockchain technology. Digitisation permits asset provenance and complete transaction history in a single shared source of truth while guaranteeing data integrity. Increased automation improves operational effectiveness overall. The real-time settlement, auditing, and reporting are made possible, and processing durations, the chance of error and delay, and the number of stages and intermediaries involvement are required to reach the same levels of trust as conventional processes are all decreased [114–116]. Table 1 discusses the significant applications of blockchain technology in financial services.

Blockchain is a technology that makes a readily available, secure, and impenetrable record of online transactions. Like the internet, a blockchain is a shared record of transactions dispersed across an extensive network of users and lacks a central authority. It is made up of several data blocks, each of which contains a collection of transactions. The blocks are said to be connected and protected by cutting-edge cryptography. Major stock exchanges are looking into how Blockchain could enable almost instantaneous stock settlements by lowering transaction times and overhead [276,277]. It increases security and transparency while automating compliance with smart contracts. The financial services sector uses blockchain technology more frequently; this invention has revolutionised the global financial system and improved its efficiency and security. Numerous ways blockchain technology is enhancing the global financial services sector. The principle of building a worldwide network utilising Blockchain that is both cost-effective and possibly transparent is known as "cross-border settlements", and it is the major advantage of Blockchain. Costs are reduced while service seekers receive value additions [278–280].

Blockchain technology can reduce costs for financial services providers and end users while enhancing payment transparency, efficiency, trust, and security. Before the advent of blockchain technology, payments between banks could take up to a week to transfer. Through digital currencies and distributed ledger technologies, payments are quicker, less expensive, and more convenient [281,282]. Central banks are testing the possibility of incorporating distributed ledger technology into redesigned payments. Leaving a digital trace on the Blockchain will also help items whose provenance determines their worth. A platform for truth and trust is an immutable, unhackable, distributed ledger of digital assets. The consequences are enormous for practically every sphere of society, not just the financial services sector. There is a significant demand for blockchain software engineers, which drives up the cost of creating and maintaining blockchain-based products. Although there are many benefits to using blockchain apps, it can be challenging to integrate them with older systems and off-chain data. There are some obstacles that developers must overcome before they can link their applications with services offered by different blockchains [283–286].

8. Discussion

The financial services sector could profit significantly from the development of blockchain-based solutions. Decentralised finance was made possible by the use of Blockchain in financial services. It is a form of financing that employs smart contracts and blockchain technology to do away with middlemen from the financial services industry. Various financial institutions and organisations can benefit from Blockchain to build trust, promote transparency [287,288], and cut expenses. Blockchain technology can be used by businesses in many vital areas, including financial software and systems [289–293]. Banks are reluctant to discuss possible blockchain applications in public, but some have just ordered studies to figure out where they can. Financial technology companies have developed into a sizable segment of the financial services sector by enabling investors to open accounts with virtual advisors and make their own financial decisions. The importance of fintech in the global financial system and its relationship to Blockchain will grow together. Because investors get more value for their money and there is a balance between automation of financial services and cheaper costs, this innovation may benefit consumers.

All around the world, financial services are still centralised and multi-layered. Financial data is frequently kept in centralised databases and must go via several intermediaries, such as the front office, back office, and other places. The system lacks transparency, and data protection depends only on middlemen and database security. There is a big chance of data leaks and server hacking even if the databases are well-protected. Digital currency-based blockchain technology has the potential to be used for both domestic and international fund transfers. Because they have already made significant investments in centralised systems, banks are likely reluctant to adopt blockchain technology domestically, but they would greatly profit from it globally. International transfers benefit from the vast differences in rules and regulations and IT systems between banks in different countries.

The banking industry cannot function without auditing. Lack of openness hinders financial auditing, a time-consuming and expensive process. Without openness, intermediaries might divulge private data while conducting the audit. It is possible to see anticipated blockchain-related legislation as another obstacle to integrating Blockchain into financial services. To decide if blockchain technology is appropriate for financial institutions and what implications it will have for businesses and consumers, regulators are examining its advantages and disadvantages. As Blockchain transforms the financial services sector, there are several possibilities for investors to get involved. One choice is to invest in businesses that run their operations using blockchain technology. Currency can be transferred with the assurance that the transaction is secure and dependable using this technology in the finance sector. The ledger is replicated many times around the network. Everybody on the network gets copies of any new transactions or added blocks.

Table 1
Blockchain technology applications in financial services.

S. no.	Applications	Description	References
1.	Fraud prevention	Blockchain technology can circumvent conventional fraud prevention techniques that require several parties to validate transactions. Blockchain is one of the best technology for any sector that benefits from the speedy movement of verifiable, fraud-free information and transactions due to its peer-to-peer network and anti-tampering features. Contracts, financial procedures, and transactions are essential to the financial sector. The use of blockchain technology can dramatically increase the efficiency of this enormous number of moving documents. Blockchain presents a problem due to its decentralised nature. The significant advancements in the financial sector are that blockchain technology can lower fraud, assure swift and safe exchanges, and ultimately aid in risk management inside the networked global financial system. Fraudsters nearly always target financial institutions. There is a chance that information will be stolen when digital payments go through payment processors and banks. Blockchains use cryptographic algorithms to process and store transaction blocks. Financial institutions might find using this cryptography less risky when processing transactions. Companies spend much time on contracts since they are a crucial component of finance self-executing contracts could considerably increase the effectiveness of this procedure self-executing contract.	[117–120]
2.	Banks and other financial institutions	Banks and other financial institutions are already using blockchain financial institutions to enhance their offerings, minimise fraud, and lower client fees. Because systems often pass through many banks on their approach to the payment's eventual destination, international money transfers have been delayed and expensive. Blockchain has the potential to make international transactions more efficient, precise, and affordable. The financial sector is aggressively adopting blockchain technology. Numerous financial companies, from smaller businesses to the biggest names in the sector, invest in blockchain stocks and support the usage of blockchain technology. For the best outcomes, blockchains need to be widely adopted. This is particularly true in the financial services sector, where numerous businesses cooperate and need a standardised way to handle transactions. For instance, each bank engaged in the transfer must have adopted Blockchain before it can be used for money transfers. In the financial industry, peer-to-peer transactions are possible with Blockchain. Because smart contracts will be able to manage transactions successfully, it means the elimination of intermediaries. Instant payment settlements are made possible as the system's layers are decreased. Cross-border payments can also be instantaneously undertaken by using blockchain payment systems.	[121–125]
3.	Calculate credit scores	The Blockchain enables new banking and finance products and services, shared operating models, more effective processes, cheaper costs, and business networks that are more open, inclusive, and secure. Financial service providers' accountants and compliance officers can provide detailed information during audits. It promotes unethical conduct, dishonesty, inconsistent compliance, and protracted auditing periods. With Blockchain, the auditing process in financial services can be expedited. Due to the immutability of blockchain data, auditors can utilise them to determine whether compliance requirements are being met and what is happening within a certain. Blockchain might also make it possible for companies to calculate credit scores using non-traditional criteria. The system transparency could be achieved by managing credit scores on a blockchain. In order to assess a person's creditworthiness, lenders can use immutable blockchain records of financial transactions. Personal information about an applicant is never compromised or made public using smart contracts. Blockchain technology in finance allows providers to keep the user's legal, personal, and public information. Using an immutable smart contract, the fund investment companies can instantly monitor users and the purpose and identity of the data's users. Blockchain in financial services can thereby increase transparency in the process of investing in funds.	[126–129]
4.	Maintaining privacy and confidentiality	This maintains privacy and confidentiality while enhancing transparency, trust, and efficiency. Its private and hybrid networks are built to manage frequent spikes in network activity and hundreds of transactions per second. In the current banking system, certain payments can take up to a week to settle. Because of the multiple layers of the current financial system, each transaction must go through at least two intermediaries before it can be resolved. In the case of cross-border payments, these intermediates could be the front and back offices of a bank or outside firms like currency exchanges. One option to guarantee security and authenticity in a centralised system is to have a large number of intermediaries, but this has a variety of drawbacks, including slow settlement times and higher costs. Banks can dramatically reduce the number of workers needed for this operation by using smart contracts to automate approval workflows and clearing computations, which will assist shorten processing times. In the worldwide financial sector, there are trillions of bank records, from personal account information to ledgers of stock market transactions that list stock purchases. Blockchain digital ledgers could be used to record the vast majority of these transactions because they are immutable and guard against fraud.	[130–133]
5.	Keeps track of transactions	A blockchain is a decentralised ledger that keeps track of transactions. Automated contracts, quicker and less expensive transactions, and improved security for financial service providers could all result from this technology. Although there is still a long way to go before blockchain technology is widely employed, several financial institutions are already utilising it. Blockchain-based financial organisations might be able to offer quicker money transactions. They want this techno to switch from conventional computer systems to Blockchain-whether they want it or not, based on payment gateways. Banks eventually need to switch over because traditional payment mechanisms are less secure. Automating transactions necessary for trade finance after adopting blockchain solutions would be highly advantageous to the financial services sector transactions' decentralised nature and enhance bank record security or security for banks. Conflicts about omitted or inaccurate transactions would be history because the other participants in the transaction would also obtain a record. Blockchain technology might enhance current systems in investment banks' clearing and settlement procedures. Banks must rapidly and securely record many transactions since they must detail all loans and securities on their accounts.	[134–139]

(*continued on next page*)

Table 1 (*continued*).

S. no.	Applications	Description	References
6.	Assurance of security and transparency	Blockchain in financial services allows for the simultaneous assurance of security and transparency. Security risks are made more likely by the system's lack of transparency because nobody knows what is happening until something goes wrong or data is compromised. Even though nobody wants their financial information to be made public, having some degree of transparency in the system is advantageous and essential for financial service providers and their clients. Ownership can be more easily tracked because a distributed ledger is practically challenging to modify. The ledger can validate information for ownership transfers and liens, improving trust. Blockchain technology enables automation, reducing the cost, complexity, and time required for transactions. Smart contracts may record when a buyer pays and delivers and take care of any problems that might occur during the transaction. Automated systems function continuously and reduce human mistakes. Startups can compete with established banks using Blockchain's low costs, encouraging financial inclusion. Due to limitations like minimum balance requirements, access restrictions, and fees associated with using a bank, many consumers are looking for alternatives to banks. Blockchain can offer a substitute for traditional banking by utilising digital identification and mobile devices.	[140–144]
7.	Helpful in money transaction	Blockchain enables people to transfer and receive money without needing several third intermediaries. Blockchain will uphold transparency, guaranteeing the integrity and morality of those who supply financial services. It is simple to spot any shady transaction activity. Auditing procedures will go more quickly because all information will be accessible. Prior to Blockchain, mediators were required to build trust and execute transactions. By employing immutable smart contracts, Blockchain in finance enables borrowers to bargain directly with lenders about the interest rate, payment schedule, and transaction length. Smart contracts enable negotiations between lenders and borrowers. The smart contract increases the total amount owed to the lender by late payment fines if borrowers do not adhere to the requirements. Banks and other financial organisations require an applicant's credit score before proceeding with a loan application. The lack of credit rating mobility is one drawback of the existing credit management system. The current credit score of an individual is no longer valid in another nation. Blockchain keeps track of information in a ledger, with each block including details on transactions and a different hash that points to the block before it. Additionally, copies of the transactions are sent to every user on the network. These features immune blockchain technology to distributed denial-of-service assaults, hackers, and other types of fraud.	[145–149]
8.	Boosts stakeholder's confidence in the transaction	By utilising sophisticated cryptography immune to hacking, Blockchain accomplishes this and boosts confidence in the transaction environment. Numerous financial applications of Blockchain exist, including managing trades and transactions. Investors would be wise to understand how Blockchain is transforming the system and how to get and manage exposure to this development as our global financial system becomes more integrated with the digital age. The financial industry must take significant risks, like building intermediary trust, to provide loans. The failure of a counterparty to fulfil its obligations and the credit risk brought on by knowledge asymmetry are additional concerns. Furthermore, commercial banks focus on loan tracking, and monitoring ultimately depends on intermediaries. Financial service companies do not have any tested risk-management techniques or methods. The financial industry is where Blockchain's most well-known uses are used. Blockchain may be connected to digital currency like Bitcoin. Cryptocurrencies use blockchain technology, a digital currency, to serve as an investment or money. These applications might lead to financial product accessibility improvements, cost savings, and other radical adjustments.	[150–153]
9.	Banking operations	In banking and financial services, the usage of Blockchain may make peer-to-peer transactions possible. Financial service providers can therefore put to rest any worries about the function of intermediaries in peer-to-peer transactions. Blockchain technology can be utilised with data immutability, improves accuracy, and smart contracts speed up transaction settlement. Most significantly, keeping track of every network transaction can help to lower credit and financial management risks. Therefore, integrating Blockchain into the finance function may help financial service providers better manage risk. Market participants see Blockchain as a way to improve reporting and compliance through real-time access to immutable asset-level information, achieve superior execution, and create new asset classes and structures through facilitated innovation and lower barriers to entry. Blockchain is a way to reduce the need for reconciliation and due diligence. Using Blockchain to execute transactions in real-time, distribute and enforce business rules, cut costs by doing away with middlemen and streamlining infrastructure, lower the risk of data loss, and increase end-to-end predictability and transparency. Blockchain technology is fundamentally easy to understand. The system consists of a shared database, where each entry has to go through peer-to-peer networks to be verified and encrypted.	[154–158]
10.	Improve client affordability	Blockchain has the potential to improve client affordability, reduce fraud risk, and increase transparency in the financial services sector. Blockchain can increase the transparency of the financial sector because users conduct transactions on a public ledger. This openness can reveal fraud and other inefficiencies, leading to problem-solving that can reduce the risk for financial institutions. The online world is becoming a haven for scammers as customers grow active there. Blockchain technology has the potential to allay this concern. Blockchain payments and transfers are quicker and more traceable than traditional banking. Blockchain might likely be helpful in the real estate industry, given the volume of activity there. Immediately confirming finances would hasten the sale of homes, prevent fraud via encryption, and ensure openness throughout the purchasing and selling process. According to proponents of blockchain technology for identity management, people would only need to disclose the bare minimum to establish their identities. Voting could become more widely available and more secure using blockchain technology. Blockchain technology would render hackers helpless since, even if they managed to access the terminal, they would be unable to influence other nodes. Blockchain technology can significantly improve the labour-intensive and prone-to-human-error process of filing taxes. This is provided that there is enough data saved on the Blockchain.	[159–163]

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Financial or technological firms who view Blockchain as a disruptive technology and wish to be specialists in it can sell services to customers. This includes businesses specialising in the development of blockchain technologies. This also provides services to assist companies in integrating Blockchain for improved productivity, scalability, and expansion. Many computers in a network use a distributed, decentralised

Table 1 (*continued*).

S. no.	Applications	Description	References
11.	Useful for international payments	Everything could change as a result of Many large banks have embraced blockchain technology by many large banks for international payments, which saves time and money. Blockchain money transfers allow users to send and receive money electronically using their mobile devices, doing away with the need to travel to a money transfer location, wait in line, and pay transaction fees. Most money transfers occur through financial institutions like banks or credit card processing businesses. Worldwide, blockchain technology is witnessing revolutions. Whatever we look at, there are blockchain applications in every field. By utilising Blockchain, many firms are growing in the supply chain, healthcare, logistics, finance, and other industries. Blockchain applications' primary objective is to make business operations more transparent and effective. Businesses are starting to understand how blockchain technology may benefit them and help them expand. The need for new blockchain platforms is steadily growing as businesses experiment with various platforms by creating blockchain applications. Blockchain technology is well-known because of its openness and decentralisation. Many businesses are thinking about developing cutting-edge financial apps on blockchain systems. Immutability, security, and decentralisation are not issues with blockchain-based financial applications. Many companies are focusing their efforts on this area.	[164–168]
12.	Minimise expediting of the transfer procedure	Blockchain payments minimise or completely do away with fees by expediting the transfer procedure. When customers write a bad check to pay for goods or services, the business suffers a loss, must pay additional fees, and may need legal action to recoup the money. With blockchain-based payments, businesses can be sure that the transaction will be finished in seconds or minutes. Blockchain allows it to do away with financial intermediaries, cut expenses, and streamline several operations. It can be used by banks, for instance, to expedite document reconciliation during factoring. Additionally, it gives banks access to a pooled database of scammers, preventing money laundering. Blockchain technology enables the automation of several processes and the removal of mediators from financial operations. The financial system's efficiency is increased through lower costs. Numerous worldwide norms and regulations that control importer and exporter operations are necessary for trading financing. It involves completing forms and entering information into registries. For all parties involved in international trade, blockchain technology promotes transaction transparency. Importers and other stakeholders can save time and money by using blockchain technology to simplify the complex world of trade finance.	[169–174]
13.	Speedup transaction system	Blockchains offer a distributed, unchangeable record of transactions, which financial institutions can use for recordkeeping and reporting to regulatory bodies. Blockchain technology's speedier transaction settlements can improve a range of financial services. Vendors will receive payments sooner, lenders will be able to fund loans more quickly, and stock exchanges will be able to settle purchases and sales of stocks instantly. A long-standing issue for banks may eventually be resolved with the use of blockchain technology. Verifying the identities of its clients is the responsibility of the banks. Several businesses are already developing blockchain technology to help banks and other financial institutions establish identities. This innovative technology protects information transfers while they take place. Blockchain aims to lower transaction costs while also increasing its effectiveness and speed. The technology offers investors a wide range of prospects with its diverse applications that may be integrated into other businesses. The risk of intercepting information through different financial intermediaries increases the fraud likelihood. The cryptographic techniques used by the Blockchain, which offer security in the transmission of information between participants, can close this oversight gap. Blockchain allows customers to save money on traditional financial services as investors turn away from financial advisors to avoid paying more significant fees.	[175–179]
14.	Enable digital currencies	The most recent generation of blockchain-based assets is digital currencies. Although digital currency is already in use, blockchain businesses are lowering the entry barrier and offering a seamless exchange of the most well-known cryptocurrencies as a banking substitute. The promise of blockchain technology and cryptocurrencies is being recognised by many financial organisations even though banking is subject to several rules and regulations. By removing reconciliations and providing assurance over transaction history, Blockchain could broaden the scope of accounting, considering more factors now viewed as being too difficult or unreliable to measure, such as the worth of a company's data. Due to the distributed, unchangeable transaction records that blockchains offer, financial institutions can utilise them to maintain records and books while still adhering to legal requirements. Finance blockchain applications' quicker transaction settlement times can enhance current financial services. For instance, lenders will be able to fund loans more quickly, suppliers will get paid faster, and stock exchanges will be able to settle purchases and sales of securities faster. Applications for the property blockchain eliminate the need for individual and paper-based communication, cutting expenses and human error while accelerating the process. Borrowers and financial institutions gain from eliminating mediators since it enables them to provide more competitive pricing and decrease staff costs.	[180–184]
15.	Ease in the Auditing process	The auditing process could be more straightforward using Blockchain in the finance industry. The immutable blockchain records enable auditors to verify that compliance requirements are being met while offering total transparency into the financial organisation's events. Blockchain can help maintain transparency by guaranteeing financial service providers' integrity and moral conduct. With Blockchain, it is easier to follow any suspicious transaction. Additionally, Blockchain offers immediate access to all financial data, reducing the time needed for auditing procedures. By establishing connections with other organisations, markets, and economies around the world based on transparency, security, and trust, dedicated blockchain enterprise platforms have the potential to transform the way businesses function on a global scale. Through computer code, blockchain technology enables the development and automation of business logic, confirming each stage of the business process with accuracy, security, and time control. Modern private blockchain networks are built to manage spikes in network activity and hundreds of transactions per second. Numerous companies have been researching the advantages of Blockchain for years. Blockchain technology is used in letter of credit transactions to connect banks and businesses for an end-to-end digital letter of credit independent of other systems. Blockchain, an emerging technology, will significantly impact the commercial and financial industries. It sheds light on how professionals will need to advance their skills and get ready to adopt cutting-edge technology that will influence the future of business and finance.	[185–190]

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Table 1 (*continued*).

S. no.	Applications	Description	References
16.	Financial services	Several financial services are being developed using blockchain technology. Investment in blockchain-based financial applications has significantly expanded. Many firms are gradually showing progress with Blockchain in the financial services ecosystem. With identical copies stored on every network computer, Blockchain Technology is a vast, distributed ledger that runs on millions of devices and records anything. Most of the nodes in a blockchain network must run some algorithms when a new transaction or an edit to an existing transaction is received to evaluate and verify the history of the proposed transaction and reach a consensus that the history and signature are valid. Only then is the new transaction accepted into the ledger. In a blockchain, a data structure represents a financial ledger entry or transaction record. The ledger and its existing transactions are presumed to be of high integrity since each transaction is digitally signed to confirm its legitimacy and that no one tampers with it. Blockchain enables transactions within a closed group funded by a cryptocurrency, unlike traditional value exchange systems where two or more parties must agree on the value and other economic considerations for a transaction to occur.	[191–194]
17.	Tokenisation	Blockchain technology plays a crucial role in tokenisation, the process of creating tokens on a blockchain that reflect tangible assets. The application of Blockchain in banking is growing along with the launch of Central Bank Digital Currencies. Additionally, in order to streamline fund management, financial service companies are exploring blockchain technology. Financial service companies may find it easier to manage cost management pressures if blockchain technology is used in fund administration. The development of decentralised applications is made possible by the Blockchain. Even between banks and numerous external services, including blockchains, there is a chance for interoperability. All of these aspects share the security and dependability of the Blockchain. Products that benefit from Blockchain and AI technology can be made by combining their most delicate features. A straightforward token system might also improve a platform's appeal to users and banking services. The Blockchain is mainly used to store client requests and make AI based judgments. Blockchain technology has gradually made its way into the payments industry, changing the nature of transactions. It revolutionised financial services by removing incorruptibility and fostering efficiency and simplicity by adopting new financial processes and infrastructure.	[195–198]
18.	Smart contract	A crucial component of blockchain applications is smart contracts. Users of blockchain technology must ensure that smart contract code is accurate, secure, uniform, and effective. It is crucial to test both the functionality and the controls surrounding it. Users of blockchain technology must continuously test their performance. Using smart contracts to regulate loan terms and conditions, distributed ledger technology to address communication and transaction tracking, transparency and immutable data to shed light on time-consuming reconciliations and incorrect payments, and other techniques will improve execution and servicing efficiency across the syndicated loan ecosystem. Combining machine learning data capabilities with blockchain-based smart contracts enables this dynamic. While machine learning can seek abnormalities and warn humans when identified, smart contacts can automate processes by looking for them. Financial transactions would be secure, transparent, and effective using the beneficial infrastructure. Many people view Blockchain, a decentralised technology, as a competitive alternative to historically centralised organisations like banks. As long as artificial intelligence attracts significant investment, machine learning seems to be in a position for significant expansion. The technology is projected to permeate various sectors and applications because of its versatility. Integrations between Blockchain and machine learning can potentially provide tremendous value, especially for the financial services industry. These complimentary technologies enhance security, boost performance, and regulate automation to bring about transformational change in the financial sector.	[199–202]
19.	Reduce time and expenses of financial institutions	By eliminating friction and thereby cutting down on time and expenses required by financial institutions, Blockchain can streamline various procedures, especially reconciliation, clearing, and settlement. Similar to this, the financial sector can use Blockchain to do away with the manual procedures needed to gather and distribute the various types of documents that are frequently needed for transactions, including custom forms, insurance policies, and other documents of many different kinds gathered by banks and financial services companies. Blockchain technology speeds up transaction processing. There is no need for mediators to approve financial transactions between customers due to the distributed existence. This offers a less expensive and more practical method of exchanging currencies than banks. It is the safest way to clear promises, fraud, and money laundering. In the upcoming years, blockchain adoption in the financial sector will multiply. The sector is also investigating how rapidly Blockchain instances are being used. Companies that produce consumer packaged goods have made significant investments in blockchain technology because of the promise of increased supply chain transparency. Their consumers, retailers, and food safety organisations call for more openness, and Blockchain seems to be a potential solution for this complicated industry.	[203–206]
20.	Identity management	Identity management is another great application for blockchain technology. Users can use this technology to construct their own tamper-proof, dependable, and secure digital identity. The use of passwords and user names for online accounts that are increasingly susceptible is predicted to be soon replaced with Blockchain-based IDs. People will be able to sign digital documents and perform other simple actions like logging onto websites and applications using their Blockchain identities. Any business activity dependent on transactions that occur on conventional corporate databases, which serve as the foundation for almost every financial service function, has the potential to be replaced by blockchain technology. Applications based on Blockchain have the power to upend any financial process with a lack of transparency and traceability. Blockchain is a distributed shared ledger that allows all participants to view and access information about business transactions in an unbreakable chain. Blockchain technology has the potential to upend financial industry applications because it offers permanent and tamper-proof recording of transactions in a distributed network. The advantage of Blockchain is that financial transactions may be quickly validated, cleared, and settled without the need for a central authority. Blockchain technology will significantly affect capital markets and other financial services. Blockchain will change the financial sector in the following years.	[207–210]

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Table 1 (*continued*).

S. no.	Applications	Description	References
21.	Securely store financial transactions.	This technology can also be used to permanently and securely store financial transactions. Any other information can also be stored with it, creating an incorruptible distributed record that is more secure than conventional databases. There are several uses for this application. It can be used in clinics and hospitals to compile a patient's medical history. It can also be used to safeguard creative digital items like e-books, music, pictures, and intellectual property. Additionally, it can be used to register real estate or automobiles. People are generally optimistic about using Blockchain in the financial sector. Like the Internet did for offline commerce, many industry professionals think blockchain technology has the potential to revolutionise business and financial services. By redefining interactions along the value chain, reducing operational complexity, and bringing down transaction costs, blockchain technology has the potential to revolutionise corporate processes. Blockchain technology is made up of a distributed database that independently manages a constantly expanding list of transactions that are recorded in units called blocks and are safe from modification and tampering. Most blockchain networks aspire to create a database system where decentralised institutions or agents can work together to record and retain information without any entity continuously exerting market power or control. Decentralising data storage such that it cannot be owned, controlled, or altered by a single party is at the core of blockchain technology.	[211–215]
22.	Traceability of data during the transaction	The potential use of blockchain applications to promote increased efficiency and traceability of data in transactions is one of the fundamental components of Blockchain's success. Another aspect is smart contracts, which are crucial to eliminating the need for human intervention in transaction performance. Technology thus can transform financial services in general completely. The areas of clearing and settlement, loan syndication, and financial transactional mechanics like trade finance are where Blockchain is most frequently used operationally. The Blockchain is a revolutionary new currency, banking system, and transaction mechanism revolutionising how we conduct financial transactions and the entire planet. In a nutshell, a blockchain is a distributed ledger maintained across tens of thousands of computers and keeps a running log of every transaction made on every network. This changes how banking is conducted and makes hacking impossible. Financial organisations frequently implement blockchain and AI solutions to enhance customer service. These organisations have a motivation to reduce expenses and increase value, just like any other company. By utilising both technologies in corporate power processes, those who supply financial services can increase client value while maximising their profits.	[216–219]
23.	Assist in enhancing capital markets	Systems built on the Blockchain might potentially assist in enhancing capital markets. Traditional trade finance techniques have been a significant source of annoyance for companies because the drawn-out procedures usually cause operations to be disrupted and make managing liquidity challenging. Cross-border trading involves many variables and generates much paperwork when sharing information like the place of origin and product specifics. Blockchain has the potential to ease cross-border procedures and trade finance transactions. It makes it easier for firms to transact with one another beyond regional or geographic boundaries. Because everyone involved in a blockchain transaction must agree on a transaction before it can be completed, and anybody can inspect the updated ledger following a transaction, blockchain payments are also incredibly safe. Most investment bankers request credit and financial information before investing. They have to guarantee that their money is secure. Maintaining a ledger of investments and validating accounts is relatively easy using cryptocurrency. There are several ways businesses can leverage Blockchain to attract funding, even without investment firms. Blockchain provides a wide range of intriguing financial applications. In order to offer speedy and transparent financial services, many blockchain companies are also creating cryptocurrencies and blockchain applications. Blockchain can revolutionise how banks conduct business by facilitating quicker payments, more detailed audits, and more thorough identification despite some concerns.	[220–224]
24.	Digital currency transactions	Blockchain is most frequently used for bitcoin transfers, which are digital currency transactions. Its independence from a nation or institution lowers the risk of currency inflation or devaluation. The necessity for transaction verification by a central authority is removed when using Blockchain for financial transactions. Blockchain offers a wide range of possibilities and difficulties. Applications for blockchain technology are now accessible to complete financial transactions and clear the exchange of many different financial assets. Within a short period, the transaction was finished. In contrast, a comparable transaction using a paper-based system can take a week to complete. Blockchain's distributed-ledger design has the potential to help banks in several commercial sectors, including payments, asset management, loyalty, and lending, by enhancing security, speed, and operational efficiency. Blockchain technology can significantly impact these issues, which can help regulators, financial institutions, and people in many ways. Decentralisation and immutability, two fundamental aspects of blockchain technology, are essential in this situation. Blockchain technology can increase private regulatory compliance and help regulators by making financial services more transparent. The auditing process can be made simpler and less expensive for financial organisations by obtaining a comprehensive perspective and a single source of truth for their assets and transactions.	[225–228]
25.	Facilitate trading	Trade finance, which refers to the financial goods and mechanisms that facilitate trading, is becoming more and more significant in today's world as global trade increases. By recreating the entire process on a blockchain, this technology has the potential to increase trade security, efficiency, and transparency. As a result, quicker procedures are swiftly automated, and human errors are removed, leading to the development of trust through open transparency. Open, distributed ledger technology, such as Blockchain, transactions between two parties can be efficiently and permanently recorded. A blockchain is composed of discrete data blocks that each includes a collection of related transactions linked to one another in a specific sequence. All parties can exchange a digital ledger across a computer network without a centralised authority or intermediaries. The speed of blockchain technology has numerous potential advantages for the financial industry. Greater security and transparency are equally crucial as increased productivity. Blockchain transactions' payment processing costs are lower since they do not need bank resources or authorisation from a third party. Transactions and their impact on the many contractual partners use blockchain technology's unchanging and explanatory nature. This information is unchangeable, which promotes transparency and precise analysis.	[229–235]

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Table 1 (*continued*).

S. no.	Applications	Description	References
26.	Promotes data confidentiality	The financial and banking sectors could undergo a major transformation by using Blockchain. However, it might have significant effects in other areas as well. It promotes data confidentiality and integrity, which raises the calibre of services. Some odd use cases include voting, sharing electricity, charging an electric automobile, and streaming music. With its promise of safe and quick transactions, Blockchain is expected to play a significant role in the digital world. Banks worldwide are now utilising blockchain technology to its full potential after realising that it is not just for cryptocurrencies. Blockchain will play a vital role because banks and financial organisations seek to make their goods and services quicker and more accessible. Banks will be unable to carry out online financial transactions without identity verification. Customers dislike the lengthy authentication process of several steps, however. It is possible to employ face-to-face verification, authentication, or authorisation. Every new service provider must go through these procedures for security reasons. Blockchain will facilitate quicker verification procedures for consumers and enterprises. This is due to the secure reuse of identity verification through blockchain technology for other services. Blocks of blockchain data are kept on nodes. Larger servers, laptops, and desktop computers are a few instances of nodes. They are responsible for maintaining, distributing, and storing blockchain data.	[236–239]
27.	Increases stock trading transparency	Blockchain increases transparency in stock trading since it offers a decentralised platform. Blockchain will end the convoluted multi-person engagement process. Smart contracts can be used to record transactions on the Blockchain. Blockchain technology has the potential to restructure banks, speed up transactions, and modernise stock exchanges in the financial services sector while preserving appropriate security. The digitisation of accounting has been relatively slow. This is due, in part, to the necessity of meeting strict regulatory standards for the legitimacy and integrity of data. As a result, another industry that Blockchain has the potential to revolutionise is accounting. This technology will streamline double-entry bookkeeping procedures while also simplifying compliance. Instead of maintaining separate records based on transaction receipts, companies can input transactions directly into a joint register. The fundamental goal of blockchain technology must be kept in mind to realise this potential. Furthermore, high-quality data must be given to machine learning programmes to succeed. These technologies, whether they exist together or separately, are here to stay despite the uncertainties. Integrating blockchain technology and machine learning may be the following major forces transforming the financial sector.	[240–244]
28.	Maintain financial ledger	Blockchain is an accounting technology. It is focused on the ownership transfer of assets and the maintenance of a precise financial ledger. Accountants' measurement, sharing, and analysis of financial information are significant concerns. Primarily professionals are concerned with managing financial resources best or calculating or quantifying property rights and duties. Blockchain clarifies asset ownership and whether or not accountants have obligations, and it can increase productivity dramatically. Blockchain adoption must be widespread if transactions are to be speedy and easy. Because businesses in the financial industry interact with one another and need a framework to utilise when conducting transactions, it is particularly crucial. For instance, all banks engaged in the transaction must adopt blockchain technology if a bank wishes to start a fund transfer utilising the platform. The use of blockchain technology in the financial services industry is still in its infancy. We expect interoperability and advancements in transaction processing to be two major future advances. The benefits of technology for financial institutions will expand due to these improvements. Implementing Blockchain in the banking and financial industry will reduce transaction processing time, decrease paperwork, and establish a safe environment. In addition, Blockchain is anticipated to create new cost-saving options. It could enhance client experiences and encourage safer data transactions.	[245–248]
29.	Facilitates communication	Blockchain can facilitate communication between parties engaged in transactions while also disseminating proof of transaction agreements to all parties. A "distributed ledger," or shared database duplicated and synchronised by a decentralised network, is what Blockchain refers to. Users can access blockchain apps through a browser or specialised desktop programmes, and a blockchain network is linked to the internet. Blockchain has the potential to alter several other industries, including manufacturing, sustainable energy, electronic health record management, and more; the banking and finance sectors are where Blockchain has found the most adopters. Distributed ledgers use independent computers to record, share, and synchronise transactions in many electronic ledgers instead of centralising data as in a traditional ledger. The financial industry could undergo a major change due to this technology, becoming more dependable, efficient, and robust. On a public ledger, users carry out operations using Blockchain. As a result, the industry is becoming more transparent. Such transparency can help reveal inefficiencies and prompt problem-solving as the risk to financial institutions reduces. Financial organisations can use Blockchain to administer bank guarantees and track various parties. It simplifies matters for both businesses and customers.	[249–253]
30.	Knowledge sharing and collaboration	Blockchain will similarly revolutionise finance and accounting operations to how the internet revolutionised knowledge sharing and collaboration and has started to catch the attention of finance and accounting professionals. Removing the necessity for accounting transaction management among businesses and related stakeholders like banks, Blockchain and distributed ledgers may someday be the way to merge the commercial world's recordkeeping. There are numerous uses for Blockchain in the financial, accounting, insurance, trade finance, payments, settlements, and auditing industries. Many organisations are trying to get from proof of concept to practical application. Blockchain proponents think alternatives to the current time-consuming and expensive banking operations can be made using this technology. Banks are decreasing the number of intermediaries and participants in transaction processing. The sectors of finance where Blockchain could revolutionise our industry are essential to financial professionals, the banking sector, and audit heads. To help senior management make decisions, they should take the initiative and steer the conversation. Accounting and accounting will no longer require transactions to be recorded using the conventional double-entry technique and will instead use a single record to maintain track of all transactions.	[254–257]

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Table 1 (*continued*).

S. no.	Applications	Description	References
31.	Secure domestic and international payments	Blockchain technology can enable direct and secure domestic and international payments with few or no intermediaries. Blockchain can also simplify the procedure and hence considerably save costs. Using blockchain technology, users may control and store their data on a blockchain. The industry claims that Blockchain is appealing because it offers the possibility of cost reductions, new operational efficiency, and increased accuracy and transparency. Due to decentralisation and peer-to-peer trades made possible by Blockchain and distributed ledger technologies, financial transactions are becoming more efficient on a global scale. By their very nature, these technologies have shown to be quite successful in streamlining conventional transactional procedures and allowing fast global payment options. Blockchain can be set to work in a variety of ways to achieve transactional consensus and specify known participants in the chain while excluding everyone else. The most well-known application of Blockchain is bitcoin, which uses a public ledger open to participation and anonymous. Many organisations are adopting blockchains to regulate who participates in transaction activity for more private uses of Blockchain among a limited number of well-known participants.	[258–261]
32.	Increase supply chain traceability	Blockchain technology has the potential to increase supply chain traceability and transaction transparency. Paperless trade would significantly improve the supply chain by reducing costs, eliminating documentation errors, and speeding up the delivery of papers to customers. The use of blockchain technology for supply chain monitoring is straightforward. Businesses may uncover supply chain inefficiencies and spot products in real time by getting rid of paper-based trials. As goods move from their origin to the merchant, Blockchain enables businesses and even consumers to monitor their quality. By becoming the standard for loyalty benefits, Blockchain also helps to change the shopping experience. Blockchain is a system that holds everyone to the utmost level of accountability, as revolutionary as that may sound. There will be no more omitted transactions, mistakes made by people or machines, or transactions carried out without the parties' approval. Blockchain verifies a transaction's legitimacy by recording it on the central register and a networked distributed system of registers connected by a safe validation process. Decentralisation means that no single person or organisation controls a blockchain. It is unchangeable in any way. A node, which can be any smartphone, computer, or larger server, records each transaction or block, and there is nothing that connects the nodes.	[262–266]
33.	Boosting productivity	Blockchain technology has the potential to revolutionise the financial industry by boosting productivity, transparency, and security, cutting costs, and spurring a previously unheard-of wave of innovation. One of the most popular issues in the financial sector is Blockchain, the technology that underpins the cryptocurrency Bitcoin. Many of the largest banks in the world and other critical financial organisations have already started initiatives to look into the potential of Blockchain. The middlemen or centralised authorities that have historically handled, authorised, or verified transactions are no longer necessary because of the widespread control and total transparency that blockchain technology brings to the transaction process. Users may examine all trade-related data in one place in real-time using distributed data repository built on the Blockchain. Trade finance services are being developed from the intricate web of participants, complete with manual procedures and documentation. The sell-side and buy-side settlement processes in syndicated lending are intended to be sped up using Blockchain, saving time and millions of dollars. Blockchain technology is being embraced by all sectors of society, including healthcare and entertainment, for several uses. On every level, this technology is upending conventional approaches to data security. This technology can help maintain the interaction between technology, user data, and privacy as the digital revolution develops. It can aid in data management and emphasise privacy more.	[267–270]
34.	Management of digital assets	The comprehensive management of digital assets in a reliable, traceable, automated, and predictable manner is now possible by using blockchain technology. The unique feature of Blockchain is how each "block" is connected and secured with encryption. Blockchain technology promises to make it possible to handle foreign payments quickly, securely, and affordably by using encrypted distributed ledgers that offer reliable real-time verification of transactions without the need for middlemen like correspondent banks and clearinghouses. Blockchain offers distributed ledger architecture and transaction immutability, both of which are necessary for removing the need for a trust enforcer in the ecosystem. By establishing a setting where trust is not a concern, tamper-proof distributed data enables counterparties to carry out their operations with certainty that they always possess the exact version of the truth and that its history cannot be altered. Transparency among market participants will dramatically enhance by using blockchain technology. Blockchain solutions promote the construction of an open, real-time ecosystem activity log accessible to all market participants. Blockchain has preserved an immutable record of transactions and asset ownership since the asset first appears in a transaction on the network. Due to the decreased risk, many asset types no longer require the related mitigation operations.	[271–275]

ledger blockchain to record transactions. Due to its structure and inherent characteristics, Blockchain is safe, transparent, and almost hard to alter. All transactions are accurately and chronologically recorded on a blockchain. Since everyone on the network has a copy, it is complicated to change or remove transactions or add unverified data. A concerted attack on thousands or possibly hundreds of thousands of machines would be necessary for this to succeed, which is doubtful. Consumers and financial institutions encounter several issues and difficulties when sending money abroad.

Blockchain-based payments eliminate all of these problems, increasing confidence. This technology can transform the banking sector in ways other than money transfers. A blockchain is a terrific tool for tracking transactions and ensuring accurate, secure data. Although blockchain-based payments are swift and reversible, many consumers are worried about online scams. Big transactions, in particular, are also less expensive than using banking services. The safest payment options include cash, wire transfers, and cashier's checks; however cash cannot be tracked, wire transfers take time, and cashier's checks can be faked. Nearly every area, including finance, supply chain management, and healthcare, has been significantly impacted by the radical new tendencies that Blockchain helped to establish. The public first became aware of blockchain startups two to three years ago. Nowadays, almost every modern business is seeking methods to use blockchain technology. In its most basic form, a blockchain is a distributed ledger system that functions as a decentralised ledger.

9. Limitations

Switching to blockchain technology can be expensive and time-consuming, especially given the scarcity of qualified blockchain developers. Smaller financial companies, in particular, could be reluctant to invest in modernising their current systems. Data on a blockchain cannot be altered. Although this is a benefit of employing Blockchain, financial companies that regularly need to change stored data may find it problematic. To implement Blockchain, companies would need to alter their current procedures. Both the development

of blockchain technology and its use in the financial services sector are still in their infancy. The two most crucial blockchain innovations to keep an eye out for are our transaction processing and interoperability advancements, as both will increase the technology's utility for financial institutions. It is doubtful that blockchains will replace current financial systems in the foreseeable future. Instead, financial institutions will test out Blockchain to gauge its potential before implementing it gradually as an addition to their current systems.

The development of Blockchain is still in its early phases. It has several difficulties due to continuing changes. On the Blockchain, data updates are not authorised. Information from other blockchains cannot be exchanged or used by one Blockchain. They are unable to converse with one another as a result. Interoperability solutions must be prioritised in blockchain networks. It is expensive and time-consuming to make the switch to blockchain technology. This is true because there are not many skilled blockchain engineers. Smaller financial institutions can therefore be reluctant to make investments in addition to current system changes. These include the potential for technology to be used to facilitate illicit behaviour, hazards to users, and the financial system brought on by the current dearth of consumer protections. Blockchain may not adequately handle most of the significant issues related to each application.

10. Future scope

There are difficulties in putting blockchain technology into practice. Despite various challenges, it can be used by hundreds of financial institutions, and blockchain stocks are accepted forms of investment. It is evident that the financial sector is aware of the potential advantages of Blockchain and that it will play a more significant role in financial services in the future. Blockchain technology uses a decentralised ledger and is a form of distributed ledger technology that is secured with public and private security keys. The public key is available to all network users, and the transaction's stakeholders access the private key. As a result, the stakeholders and transaction details will only be visible to those who possess the private key, while the transaction will be visible to all network users with the help of the public key. It will guarantee system transparency while safeguarding the private financial data of the stakeholders.

Large institutions' intercompany relationships and transactions will be revolutionised by Blockchain's ability to maintain a single source of unchangeable truth, automate intercompany transactions using smart contracts and consensus mechanisms, provide visibility across disparate systems, significantly reduce intercompany imbalances, use near-real-time reporting rather than the past, and streamline and standardise intercompany supply chain processes. By ensuring that updated data is consistent across systems and by generating an audit record of changes made to client data, Blockchain can alleviate these problems in future. Financial leaders believe this blockchain use case will increase transparency, decrease friction, speed up transactions, save money, increase security, and reduce financial crimes. In future, Blockchain also makes it possible to use tools like "smart contracts", self-executing contracts built on the Blockchain with the ability to automate human operations ranging from compliance and claim processing to dispersing a will's contents.

The financial sector has attempted to test Blockchain by duplicating its current asset transactions. This gives some flexibility in how a blockchain solution will affect efficiency but ignores how it will affect the ecosystem. Blockchain software is used as infrastructure for real-time digital asset transfer between market participants. Blockchain enables the redrawing of procedures and challenging established business model orthodoxies. This technology will significantly increase transparency among market participants, thereby levelling the playing field. Blockchain's function in the banking sector in the following years is imperative to consider as blockchain applications proliferate across numerous industries.

11. Conclusion

Blockchain technology is being adopted by factories worldwide as they get more and more connected. The future factory will comprise a vast network of equipment, accessories, goods, and value-chain partners, like equipment suppliers and logistics companies. The main goal of this technology is to develop a tamper-proof ledger for digital assets like cryptocurrencies. Blockchain applications maintain data integrity, enabling marketers to target the relevant consumer segments and musicians to obtain fair royalties for their original compositions. This technology is gaining ground in banking payments. People exchange money mainly through their bank accounts; therefore, payments are crucial. Banks have long been at the forefront of the digital revolution, accepting disruptive developments in exchange for reliable payments and printing their digital currencies. Blockchain technology allows banks to track every transaction in real-time. This technology will enable banks to settle transactions on a public blockchain. Banking executives need to fulfil several requirements to become a widely used technology in the banking sector. Blockchain's ability to share information and temporarily make the property available to someone else would dramatically change our mobility. By utilising intelligent contracts over the Blockchain, it would be feasible to directly pay for and utilise a car while finding solutions to issues like electromobility. Smart contracts can be used by businesses using Blockchain in finance to upload invoices to the Blockchain. The Blockchain can contain data like payment due dates, amounts, and client information. The smart contract updates the invoice status to paid when the customer pays the bill and notifies the businesses that the payment has been received. Blockchain in financial services can assess a client's trustworthiness before trading. In the future, blockchain will play an important role and manage various activities in the finance sector.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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