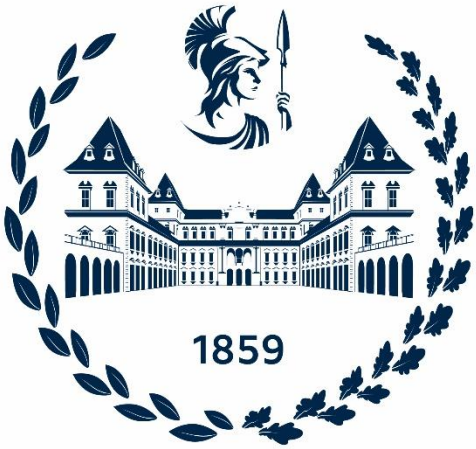

Politecnico di Torino

Politecnico di Torino

Degree Course: Engineering and Management

Department of Engineering and Management & Production

FinTech and Blockchain

Literature Review

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Abstract

Ever since the inception of bitcoin in January 2009, there has been an upsurge in the study and development of a new revolutionary innovation known as a blockchain. This technology aspires to re-model the concept of communication between humans and machines. The working model of blockchain aspired the financial sector to opt for this technology and transform the entire financial principles. The fintech sector is eagerly working and building solutions on the blockchain platform. According to the researchers, blockchain technology can help the financial sector to achieve openness, efficiencies, integrity, and protection of users' data. The implementation of blockchain in the financial sector (FinTech) is examined in this thesis. The adoption of cryptocurrency and the emergence of innovations like Non-Fungible tokens and Metaverse depicts the true picture of the future of the blockchain for the financial industry. Blockchain technology and its adoption by the fintech sector is a great threat to the banking sector but it is being observed that banking institutions will adapt and nurture it with time. Currently, regulators are hurdling for the adoption and implementation of blockchain-based applications because no uniform policy is being deployed.

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List of Acronyms

Peer-to-Peer	P2P
Financial Technology	FinTech
Transaction per second	TPS
Payment system operators	PSO
Non-fungible tokens	NFT
Decentralized finance	DeFi
Know your customer	KYC
Virtual reality	VR
Bitcoin	BTC
Proof-of-Work	POW
Proof-of-Stake	POS
Distributed ledger technology	DLT
Business to Business	B2B
Internet of Things	IoT
World Wide Web	WWW
Artificial Intelligence	AI
Decentralized applications	dApps

1. Introduction to Financial Technology

1.1 Fintech and its Evolution

Fintech is a term derived from 'Finance' and 'Technology'. It includes the development of new financial solutions driven by technology, as well as start-up organizations that provide those solutions, although it also refers to established financial service providers including banks, insurers, and many more [1]. Technology-supported innovation in financial products and services leads to improved business models, systems, etc, and has a great influence on the financial sector development, as well as the provision of financial services. The need of the customers has an impact on technological improvements in the financial sector with time. Fintech firms specialize in P2P financing, trading stocks, cryptocurrencies, crowdfunding, and others.

Since the 19th century, technology has progressed to meet customer needs, marking significant milestones. Consumer expectations are vital for the Fintech trend, but the global economic crisis is a major catalyst that has fuelled the fintech enthusiasm. In the last 100 years, the world has seen seven catastrophic crises [2] with the most recent one in 2008 putting the final nail in the coffin for the technology in the financial industry. One of the most well-known examples is Wise, formerly TransferWise, which launched as a digital bank in 2011 and processed €10 million in bank transfers in its first year [3] [4]. Wise was on average 83% lower priced than the big four UK banks on major foreign transactions, according to expert comparison site Monito, but could still be up to 90% lower in some cases [5] [6]. This fintech start-up is well regarded and adopted due to its customer-friendly services and higher monetary relaxation which is the core purpose of using technology for financial services.

The pandemic of covid-19 has opened a new era of fintech innovation. Because of the epidemic and pace with which it spreads, people have undertaken self-imposed lifestyle adjustments which have increased the acceptance of fintech. According to assessments, the pandemic's rise has resulted in a 21% to 26% increase in the overall number of everyday downloads of fintech mobile applications [7]. Digital payments and virtual currency platforms all had yearly jumps in trading volumes of more than 20%, while online banking and identity management saw more significant gains of around 10% [8].

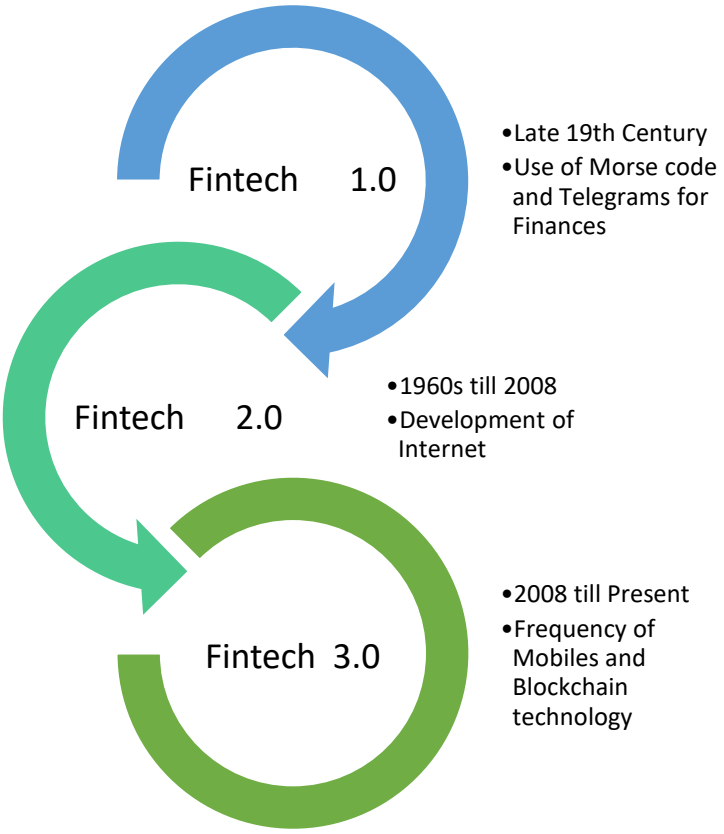

Figure 1 Fintech Evolution

1.2 Boom of FinTech

FinTech start-up has now become increasingly popular all over the world. Financial services are becoming more digitalized, allowing new entrants to flood the market. Banking institutions are heftily invested in IT across all businesses, ranging from 4.7% to 9.4%, whereas airlines and insurers contribute 2.6% and 3.3% of their business in IT [9]. Digital finance contributes to improved economic stability and much more financial intermediation for both clients and the economy [10]. Interestingly, over a decade something unique was encountered between the interaction of money and technology. M-Pesa is a unique fintech innovation launched in 2007 by Vodaphone and Safaricom in Kenya letting people move funds using their mobile phones instead of a bank account [11]. Satoshi Nakamoto, a Japanese developer, founded Bitcoin in 2009, which is a blockchain technology that maintains transactions records without monopolizing authority [11]. Following these fintech advances, a new route was charted for a wide range of fields where the sky's the limit.

Since the financial crisis of 2008, bank financing for small and medium businesses has changed considerably. In response, the smaller firms started to benefit from the fintech boom. In 2013, Netherland became the country with the highest loan rejection which is 6% to 8% throughout Europe [12]. Fintech projects are funded largely by venture capitalists and credit markets. FinTech setups in countries without significant financial regulations are more likely to acquire larger funding [13]. The flow of money by venture capitalists determines the monetary success of fintech. In 2018, globally fintech enjoyed amounting to $128 billion of funds which grew to $310 billion in 2022. Traditional banking institutions worldwide focus on actual technologies to enhance customer preservation in the next 3 to 5 years [14].

1.3 Bank's Acknowledgement

Banks are facing challenges with new disruptive technology-driven developments and internet-based services. FinTech firms have contributed to the emergence of several of these new banking solutions. Due to them, the banks are pushed to re-evaluate their limits and consider transparent interactions [15]. To overcome this potential threat, banks formed a strategic partnership with the FinTech start-ups and began to utilize their services. FinTech incubators have been formed by banks to foster innovation while keeping control over the business that is established or regulated [16]. P2P FinTech, on the other hand, does not pose a risk to banks due to security concerns [17]. Consumers are still large regarding safe transactions through the banks.

1.4 Fintech and Blockchain

Blockchain is considered the backbone of fintech technology. In 2008, Blockchain technology was introduced in the world with the creation of the first cryptocurrency which is Bitcoin. Blockchain received a lot of interest, funding, and research due to the solutions it is offering, confidence, and transactions [18]. Standard banking operations are being revolutionized with blockchain solutions into totally transparent systems that rely on robust and reliable operations. Appropriate usage of blockchain has the potential to establish a digital economy that will transform finance. The transactions using this technology will eliminate any third party and create a P2P system that is free of any influence from organizations. The blockchain opens the path for a more efficient foreign monetary flow. Normally, banks charge a transfer fee from 10-15 percent of the total money moved but with

blockchain technology it gets reduced to 3% [19]. In the last 10 years, we've seen a rapid transformation to digital banking, with far more trading options and due to the expulsion of third-party every user is now able to handle their assets on their own. Although, blockchain has a lot of pros in the financial sector due to its robust and transparent transactions it still has some risks. As it is a new technology and does not have a properly established framework worldwide it might have a problem with safety. Blockchain has restrictions in terms of technology and it's still new even though it has been around for a decade. There are no proper regulations concerning this technology which brings a great setback to this technology and limits its full potential. Although blockchain has a lot of financial benefits, it's a technology that is still exploring its limits in other sectors.

1.5 Developments in different Fintech Segments

1.5.1 Financing

The number of fintech companies are growing exponentially over the last decade. A lot of investors have found a new source of income in the form of digital innovations. The application of blockchain technology in financial markets could give investors and entrepreneurs with new capabilities to efficiently interchange information and resources without depending on centralized controller, thereby addressing the issue of trustworthiness [20]. Crowdfunding and crowd investing have become fashionably a new trend worldwide. It raised $34 billion worldwide in 2015 [21] [22]. Start-ups and other businesses are allowed to sell shares on crowdfunding sites to access cash for business developments. In response to this, the governments have outlined the proper regulation for companies to acquire seed money. Mostly the money which is raised from crowdfunding sites is from retail investors which have very little say in the working of the business. These sorts of businesses tend to fail. Another alternative to finance is an initial public offering (IPOs). Nowadays this is only available for institutional investors [23]. One of the reasons for this is that in IPOs finances are gathered from millions to billions and whereas crowdfunding is mostly for start-ups. There are many platforms for crowdfunding, but Indiegogo is one of the best available options. It has worldwide operations and is best for entrepreneurs. A P2P loan is a type of financing that connects lenders and borrowers on a single platform.

1.5.2 Asset Management

Fintech companies are very rigorously transforming digital facilities. Earlier one must appoint an assets manager to keep control of their investments and increase the portfolios. Now technology is rapidly progressing, and an example is robot advisers. Robo-advisers are the kind of financial manager who handles your investment portfolios. In terms of efficiency and cost, this technology is significantly superior. Most Robo-advisors charge annual fixed rates of less than 0.5% of the managed money [24] [25]. Betterment is one of a kind Robo-advisor. Trading is another sector that was not generally accessible to the public. Fintech has ushered innovation in this field. Anyone with a basic understanding of finance can use social trading to mimic trades. eToro is a social trading platform that was first introduced in 2007. It helps non-traders to mirror the trades of expert traders.

1.5.3 Payments

Payments are one of the most important fintech areas, and it is constantly innovating. Banks face strong competition because of these innovations. The fusion of finance and technology has given rise to a slew of new financial services, including P2P financing, digital-based banking, bitcoin, and the booming mobile payments business [26]. Digital payment is indeed the electronic flow of money over a payment interface. With the rise of e-commerce, electronic transactions technologies have become increasingly vital. The digital payment mechanism has been enhanced because of the increased mobile usage [27]. Cryptocurrency has been launched in a form of secured digital payments.

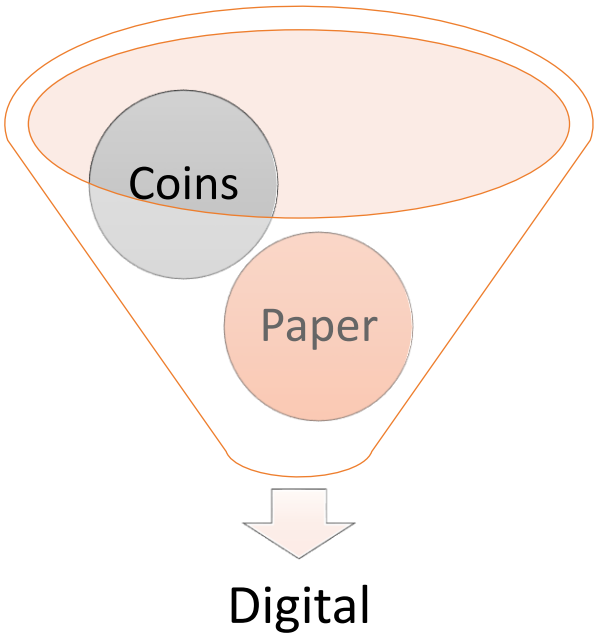

Figure 2 Payment Evolution

1.6 Regulations

Investigating the actions of financial regulators across the world we discover a fundamental shift in the regulatory framework after the global economic crisis of 2008. Most financial regulators have a highly conservative approach to bypassing any future economic crisis. Regardless of the regulator's point of view, no one can deny that the country's regulatory paradigm has a significant impact on the economy and the authorities must find an appropriate solution to promoting fintech and protecting the interest of the public [28]. The enormous growth of technology is making problems for regulators to cope with the regulations. As a result, regulators must comprehend the technology's utility to determine what should be regulated [29]. The State bank of Pakistan has emerged with innovative policies to tackle this fintech boom. The efforts made by the SBP to encourage branchless and online banking [30]. In 2014, SBP took the most critical and immediate step in encouraging fintech by writing and passing laws relating to payment system operators [31]. After the financial crisis of 2008, Wall Street banks pushed economic policy initiatives, the most notable of these is the passage of the Dodd-Frank Act in 2010. The Act targeted practically every area of financial innovation, from the establishment of new regulators to growing consumer rights to new laws governing credit rating agencies' activities [32]. The fintech sector produces various kinds of risks. Fintech's effective business model excelled in terms of profits, but it is

not without flaws. It was revealed that hacking occurred because of the theft of $50 million worth of cryptocurrency known as Ethereum, which caused its price to decrease by 38% [33]. The architecture of fintech makes it harder for regulators to determine the stakeholders who need to be regulated. The decentralization makes it harder to determine the regulation like in cryptocurrency, there is no single entity to be monitored and if they succeed in finding the individuals it depends on, they might be working from some other continent.

2. Literature Review

2.1 Innovation with Fintech

The financial sector is of immense value. With the advent of fintech, banks are entering a new phase. This is a largely unexplored sector that poses a significant problem for global financial executives [34]. Fintech has boosted the quality and agility of banking services, nonetheless, the main promise of fintech is the potential for cost reductions using digitalization [35]. Fintech has enabled the formation of a digital market, enabling both fundraising and payments for various business owners. The digital marketplace may be a highly helpful medium for doing agriculture business deals irrespective of time and location constraints [36]. As per the author, fintech has made money more approachable to a significant number of people in growing economies such as China, Kenya, India. The companies have created creative approaches for offering financial services to such consumers through smartphone applications in various locations. Governments, as proposed by the author, must encourage fintech enterprises to innovate technologies to meet market demands in a place where banks' financial services are weak [37]. According to another report, most banks continue to rely on inefficient and overpriced manual methods. Artificial Intelligence and blockchain technology advances are the most effective way to cut expenses and increase efficiency. Fintech solutions for transaction settling are, in fact, tremendously valuable [38]. Fintech focuses on internet services, which have been a driving factor, especially in developing countries.

2.2 Applications of Blockchain

2.2.1 Cryptocurrency

The industry for payment services and financial innovations serves as the primary benchmark for the growth of cryptocurrency. Cryptocurrencies have a variety of characteristics that keep them apart from traditional currencies. The security and trustworthiness of information communicated inside the system, as well as the flexibility of operations, are the primary benefits of cryptocurrencies [39]. Another research mentioned the cryptocurrency operations measured in transactions per second. The key drawbacks are significant volatility, poor bandwidth system, and expansion issues. While studying the market, Bitcoin leads

the sector with a customer base of 67% at the start of 2022 and approximately half of the overall trading structure. Due to the blockchain platform, cryptocurrencies ensure data protection and reduce information error. Although there are a lot of pros still cryptocurrency also have some drawbacks. The settling threat in a single currency may pose a risk to the world economy. Multinational enterprises will be required to set prices, but varied countries have various standards of life which will create financial imbalance globally. To replace the traditional currencies with cryptocurrencies there should be some assets to back them. If there is a piece of excellent news about crypto legalization, prices vigorously increase, and if negative news then vice versa [40].

Due to the sheer instability of cryptocurrencies, we cannot regard them as a possible money source. They are identifiable as distinctive security with significant risk characteristics and the potential for reward. The creative growth of the regulatory system for the definition and circulation of cryptocurrencies could be the solution to this challenge. The creation and growth of the regulatory system and circulation of cryptocurrencies could be the solution to this challenge.

2.2.2 Non-Fungible Token

Non-fungible token technology has the potential to completely alter the nature of digital ownership. The non-fungible token marketplace has grown to $1.8 billion in 2021, and now it's worth $5.6 billion in market valuation. Although the asset class is almost certainly in a balloon, given how concentrated art NFT is, it is specifically gained importance in goods verification and logistics that accounting for 67% of the NFT marketplace [41]. NFT can be valuable in fintech since they can represent a property as collateral with Defi. It could be a key component of the future of decentralized finance as they challenge the traditional financial system by employing crypto and blockchain technology. NFT offer any sort of information, such as a picture, a computer model, or a manuscript delivering distinctiveness. They are very secure due to blockchain technology but in case of hacking, it will still update transaction history which will be easily traced [42].

Whenever huge amounts of money are exchanged, the chance of embezzlement is always present. It's not like anyone can do embezzlement but it is performed due to the loophole present in the system like the exchanges having weak KYC which let conversion of illegitimate to legitimate funds. The presence of transparent regulations delivers more vital support for improving the bad image. NFTs are using blockchain networks which are high energy consumption platforms, but it is far less than the cryptocurrency platform. Few NFT traders are using the methodology of reducing carbon emission due to its energy consumption by populating Amazon Forest.

2.2.3 Metaverse

Metaverse is a digital world that is based on a computer-simulated environment, wherein people engage with each other perhaps through autonomous agents or by personally having graphical visualization. Users in the metaverse, create and own practically all assets. It frequently includes a burgeoning economy where users may purchase and re-sell virtual content like land and some earthly products [43]. The residents can build and create their personas, learn, and work to generate authentic money. The author in his research divided into two categories: metaverse and digital games. It has multifunctional inputs, diversified clients, network restrictions, and object coding techniques [43]. Another author investigated how the metaverse core competencies connect with the virtual workforce and how metaverse capacities differ from the conventional interaction technologies having a sort of effect on virtual endeavors [44]. Dionisio investigated the difficulties that must be addressed to transition from a collection of autonomous virtual worlds to an interconnected platform of virtual worlds, known as the metaverse, which provides a new arena for human social interaction. They focused on reality, compatibility, expandability, and universality which are all regarded as essential elements of a legitimate metaverse [45]. Murray researched that rather than thinking of VR as a mystical technology, it is framed as a channel that advances multimedia practices to support interaction and involvement. He described VR as

a visual world that constantly necessitates deliberate belief formation rather than an unavoidable and false metaverse [46].

3. Blockchain Technology

3.1 Blockchain overview

Blockchain is a decentralized system for digitally keeping a record of operations that cannot be influenced or managed by governments, institutions, or organizations. It allows a group of consumers to log transactions in a public ledger within that group, with the results that once published cannot be altered if the blockchain network is operational. We've realized the internet's security, transparency, and trustworthiness issues, and for that, the experts have been looking into ways to solve these issues since the early 1980s [47]. Blockchain has received a lot of attention, funding, and innovation within Fintech. Since it tackles two of the most problematic aspect of life and business over the internet i.e., trustworthiness and payments.

Satoshi Nakamoto wrote a whitepaper in 2008 proposing a solution that has a methodology for developing a P2P payment network utilizing digital money, which is now known as Bitcoin [48]. Bitcoin traders can authenticate and pass their ownership of that information to some other user, and the blockchain publicly records this transaction, allowing all participants to independently confirm the transaction's legitimacy. Many cryptocurrency networks, such as Bitcoin, Solana, Ethereum have been made available by blockchain technology. Blockchain may be utilized in a variety of financial services, including remittance, digital assets, and fund transfers because it enables transfers to be completed without the involvement of a bank or an intermediary [49]. As a result, blockchain technology is frequently associated with Bitcoin. Financial corporations started noticing the technology's transformative power, and capital investment started to stream into the emerging technology sector. The technology, on the other hand, is applicable for a wider range of applications and is being researched for a range of industries. The blockchain is positioned to revolutionize and alter a broad array of sectors, like digital entertainment, supply chain, network, and decentralized accreditation [50]. To further, identity authentication, crowdfunding, and maintaining official records are all examples of blockchain.

Despite the advantages of blockchain, there are still some issues like scalability. A scaling difficulty in Bitcoin is due to the restricted size and periodicity of blocks, as well as the number of transactions the network can execute. Interoperability, anonymity, power usage, safety,

and government frameworks are a few of the challenges with blockchain. Proof-of-Work and Proof-of-Stake settlement techniques are also being questioned. In POW, the miners tend to use a huge amount of electricity to mine the blocks by resolving challenges in the form of mathematical problems. In POS, the owner stakes its asset to earn more assets. Blockchain can potentially be vulnerable to 51% of cyberattacks, in which 1 node gains control of a network and exploits it [51]. One of the primary root causes could be that blockchain's decentralized structure reduces the need for central banks to regulate the economy, which does not sit well with the government. In terms of this government shows a lack of interest in the favorable regulation of the blockchain structure.

3.2 Mechanism of Blockchain

Blockchain technology is a protocol or program that works on top of the present stack of IP networks and connects to its distributed set of nodes through the internet. It is a decentralized database having information stored in a digital format on a computer. This system on the other hand is created and developed expressly for the transfer of assets allowing safe and incorruptible financial transactions. A decentralized network is composed of several equal nodes with links created between them, every node processes the record from the database, and they all seamlessly integrate. As a result, the network is extremely resistant to cyberattacks and the breakdown is rare. If a single node is attacked, the ledger's security is preserved by the other nodes [18].

A blockchain is made up of blocks that are linked together by a 64 hexadecimal digit hash signature generated for each block. To maintain security, blockchain utilizes public and private encryption keys. Earlier, there was a replication problem with the data which is resolved using blockchain technology. The identity of a transaction is logged inside the blockchain database, as well as all subsequent operations appear to be the record of its history, which is visible to everyone on the network. Blockchain mining is used to establish transactional identity and validation. Mining is a word used in the blockchain to describe the computation of cryptographic information to ensure the system's security. Mining constantly verifies earlier operations, ensuring that the block's historical order is valid and prohibiting the change of blocks containing valid transaction details. It also shields against new fraudulent blocks which try to be uploaded on the blockchain network. This process required computational power on behalf of every blockchain peer in a network. Blockchain mining

performs many financial assessments daily, obviating the necessity for recurring financial assessments.

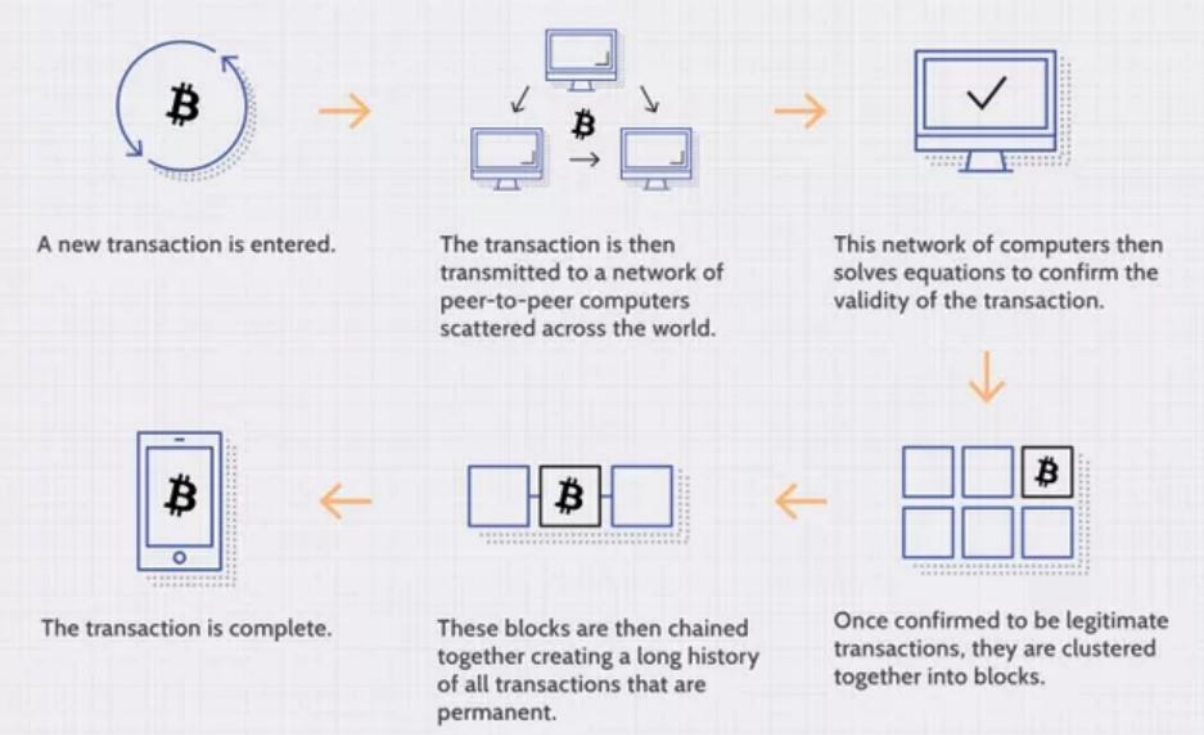

Figure 3 Blockchain Process

3.3 Types of Blockchain

Permissionless, permission, or even combination are terms that can be applied to all sorts of blockchain. Permissionless blockchains enable every user to access the blockchain network anonymously and be a part of a network, yet do not limit the privileges of the network's peers. Permissioned blockchains, on the other hand, limit access to a network and limit the rights of all those peers within the network. Due to the numerous peers to authenticate the transactions, permissionless blocks are much safer than permissioned blocks. It'd be impossible for corrupt peers to collaborate on the network. Given the multitude of nodes and many transactions, permissionless blockchains also have significant operation processing times. Permissioned blockchains are more productive because network connectivity is limited, there are fewer peers on the chain resulting in quicker transaction processing [52]. Following are the 4 types of blockchains:

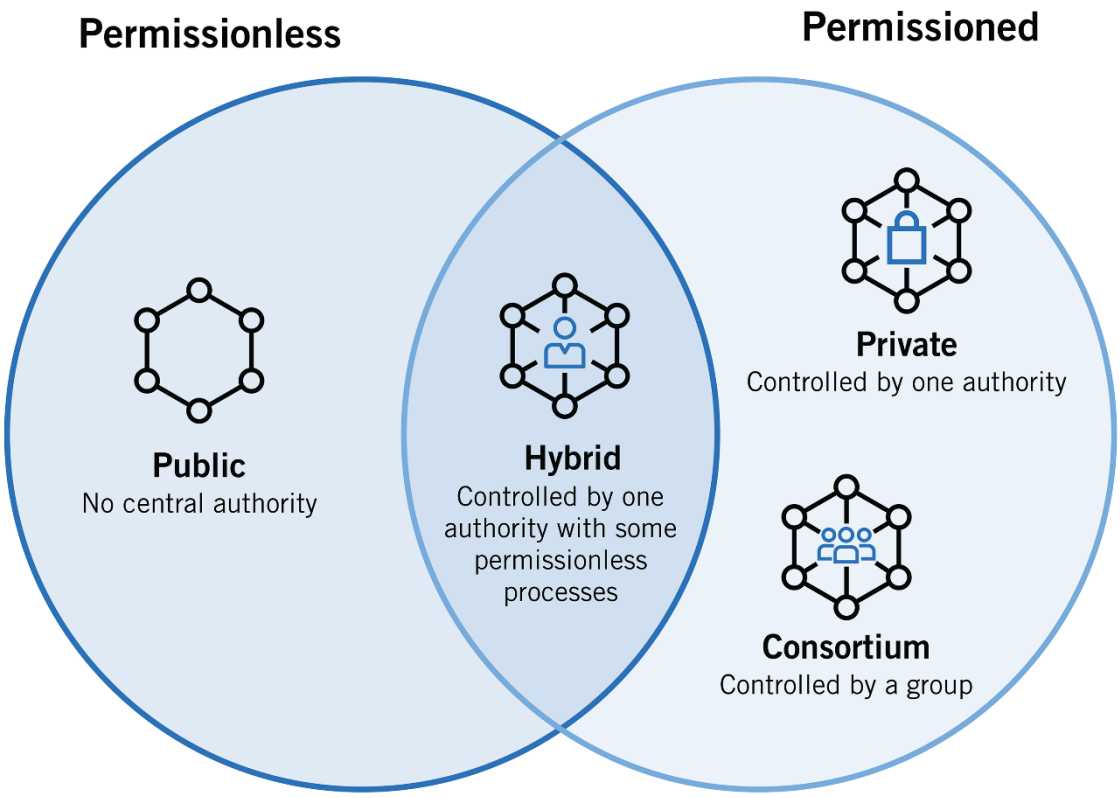

Figure 4 Blockchain Categorize [51]

3.3.1 Private Blockchain

Private blockchains typically function like a local network having verified participants. The governing body in a private blockchain determines who could be a peer. In addition, they do not always allow each peer identical access to execute operations. It is partly decentralized due to limited public access. Ripple, a B2B cryptocurrency network is an example of a private blockchain network.

3.3.2 Public Blockchain

Public blockchains are decentralized networks allowing anybody to connect. All peers of the blockchain have identical capabilities to connect to the network generating new data blocks and authenticating blocks in public blockchains. Famous examples are Bitcoin and Ethereum. The peers do the mining for the crypto coins by solving mathematical algorithms to generate blocks for the transactions demanded on the network. The miner peers are compensated for their efforts with a tiny amount of crypto.

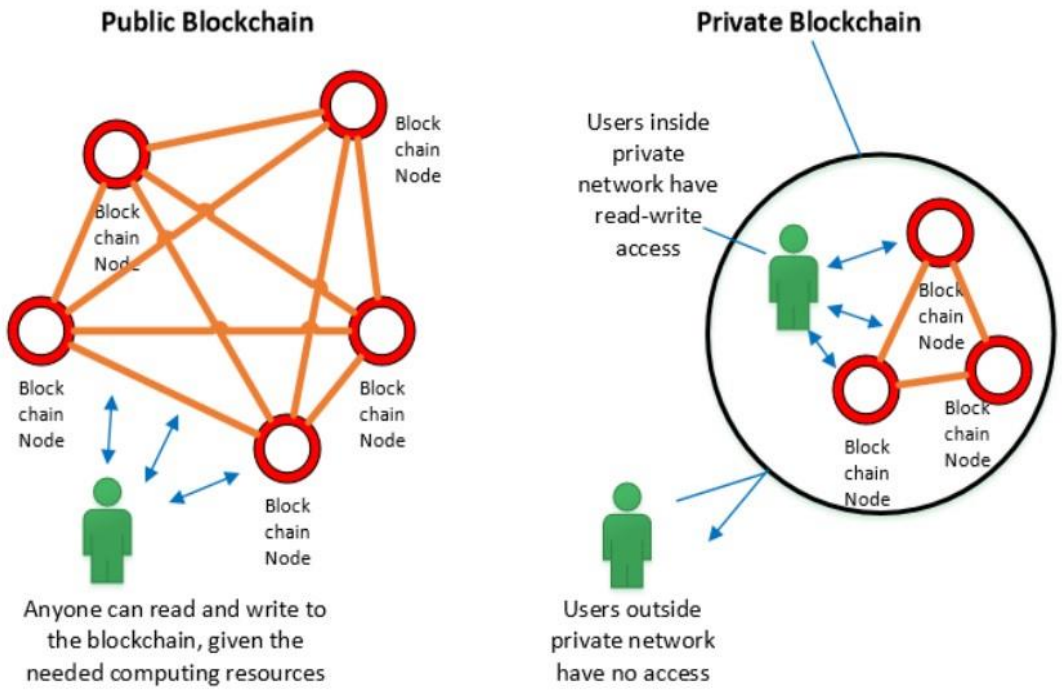

Figure 5 Private and Public Networks [92]

3.3.3 Consortium Blockchain

Consortium blockchains are administered by a consortium of entities rather than a single institute, like a private blockchain. As a result, they have more decentralization over the private blockchain, which means they have higher degrees of protection. Nevertheless, forming consortiums can be a difficult task because it necessitates collaboration among several firms, which poses operational obstacles and the threat of monopolistic practices.

3.3.4 Hybrid Blockchain

Hybrid blockchains are those that are managed by a single entity but have some supervision from the public blockchain, which is necessary to conduct certain transaction confirmations. The IBM food trust is a good example of a supply chain that employs a hybrid blockchain.

3.4 Blockchain for Decentralized Finance (DeFi)

3.4.1 Introduction to DeFi

Decentralized finance, commonly known as DeFi, is an innovative type of financial activity that is free of reliance on the institutional financial sector. Banks,

exchanges, and brokerages are all examples of financial institutions. It accomplishes this by employing a blockchain-based alternative architecture. Ethereum has been the main framework for many blockchains inventions [53]. Individuals can use DeFi methodologies to transfer funds for a variety of purposes, including loan portfolios, expanding personal investments, and daily financial transactions without the need for any intermediary. The offered gains on DeFi financial products supplement to replace the conventional benefits. To entice stakeholders, some DeFi services push high-interest rate securities. More than $11 billion was injected into DeFi platforms. DeFi is the result of three purposeful and essential technologies: Moore's law, Kryder's law, and there is still no name for the third law. Moore's law states that the number of record processing capacity rises at an exponential rate. The same holds for storage space, according to Kryder's law. The third element that has enabled DeFi is the huge expansion in communications capacity mixed with falling costs [54].

Considering the hype, DeFi has several drawbacks. In respect of the legal system, DeFi represents a threat to financial systems, as it aspires to replace the function of institutions as regulators. Due to technical reliance and communication, DeFi in any version increases digital vulnerabilities. The industry is dangerous and vulnerable to fraud because of a complete absence of regulations. In 2021, attackers stole over $10 billion from DeFi systems [55]. DeFi applications are becoming a far more convenient technology for financial fraud.

3.4.2 Peer-to-peer (P2P) Networks

A peer-to-peer framework is a decentralized networking architecture in which 2 peers, also called nodes, can connect even in the absence of a central database. Users can use the network to transfer and retain data without the need for a mediator once it has established a connection [56]. A prominent factor of this new creation of framework is that users develop a digital network with their traffic mechanism. The sudden phenomenal rise of these networks has been fuelled by several factors. One is the relatively inexpensive and easy accessibility of massive network storage facilities, and the other is enhanced networking bandwidth [57]. P2P distributed systems are quick and effective because each

peer has the same capabilities for collecting, transferring, and retrieving files. As it is a distributed network system failure is highly uncommon which means it is incredibly robust to hacking. The blockchain has been used to record cryptocurrency financial activity as a P2P log [58]. This activity is the movement of cryptocurrency. Each transaction is broadcasted to peers, who verify their legitimacy. Legitimate operations are organized into blocks and recorded in the database in a manner that manipulation is practically difficult due to the high processing energy. Therefore, as an outcome, a network that facilitates safe financial activity is created that is not governed by a central system and does not have vulnerabilities due to its peer-to-peer structure [59]. The P2P system does not provide any incentive or acknowledgment for being a highly active participant. To address the absence of rewards for enhancing productivity, it is proposed to use a blockchain-based monitoring system in which users who are more productive and active are rewarded with cryptocurrencies [60]. The blockchain's peer-to-peer structure expands the technology's range of possibilities well above digital currencies and financial applications. The architectural distinction in networks is used to classify them. The suggested are three primary categories.

3.4.2.1 Unstructured Peer-to-Peer Networks

The peers in an unorganized P2P network link and interact randomly. The above network is ideally appropriate for high volatility operations because peers constantly enter and depart the network. These networks are simple to set up, but they consume a lot of CPU power.

3.4.2.2 Structured Peer-to-Peer Networks

A system that links peers with a certain data format/interface to provide reliable peer search and data identification [61]. A decentralized hashed database that stores data is used to search for the required information. Though structured systems can reliably transmit information, they are much more regulated and have greater infrastructure and operating costs.

3.4.2.3 Hybrid Peer-to-Peer Networks

It is a network that integrates the P2P and consumer systems. The network makes use of a dataset system, which stores information about the positions of resources in the hub which is used for queries. This system outperforms its competitors because some lookup requests necessitate consolidated capabilities while also gaining from distributed networks.

3.4.3 Cryptocurrency

The introduction of smartphones and the internet have opened a variety of novel money payment systems in the market. In 2008, Satoshi Nakamoto, introduced the bitcoin cryptocurrency on an open distribution list for cryptologists, establishing blockchain architecture. Despite a monetary system that is generated and backed by a state, Bitcoin is not generated or supported by any government. This sector has exploded in popularity. It enables businesses to generate funds without the involvement of VCs and they can be exchanged without being declared on the stock exchange. There are 2 main views on the crypto sector, one is that most coins are inflated and illegitimate, and the other is that cryptocurrency might be a game-changing innovation and can be considered an assets class [62]. Cryptocurrencies operate in the following way [63], the individual has a wallet that has a randomly issued address. This address is used to generate a public key. A private key is also included in the wallet, that is needed to validate operations and verify identity. The sender transfers funds to the address of the recipient and confirms it with his or her private key.

Mining is used to authenticate the transaction. Whenever a transaction occurs, the miner examines the cryptocurrency to see if it refers to the sender or if the sender is attempting to double spend. The blockchain records the possession of the coin. To eradicate the chance of fraudulent activity the miners are needed to complete an activity that requires a lot of energy. This activity can be anything like proof of work or proof of stake. This activity also restrains the number of operations for the validation. It is so because with the mining a new coin is generated.

3.4.3.1 Proof of work

Hash system is being used to mine cryptocurrencies. It is a one-way operation that accepts a volume of data as input and outputs a predetermined length of data [64]. To help the mining process, Nonce is also used which is a pseudo-random number whose validity is for once and for a particular function. The miner receives the hash of the preceding block as input then they must pick a nonce so that when the existing hash, as well as the nonce, are hashed together, the outcome matches the crypto architecture. It's a power-consuming process. Hash values are structured in such a manner that finding the input from the result takes an inordinate amount of time, making them impenetrable [65]. Although it is a secure process, it comes with drawbacks. Almost 51% hack is found in this proof [66]. An intruder who possesses over half of the network's processing capacity removes and reverses the position of actions for the duration of their command.

3.4.3.2 Proof of stake

A miner's mining power under the proof of stake is limited to the proportion of his stake. Holders of cryptocurrencies stake the tokens to a validator. A validator is a system that has its copy of the ledger executing on a blockchain program. Validators are substitutes for miners. Unlike POW these are solely selected on the share of their stake rather than contending with other processors to resolve complicated riddles [67].

3.4.3.3 Lending

Crypto lending is a form of decentralization in which lenders can lend their cryptocurrency to a variety of borrowers. In this method, investors would be compensated with interest income. The crypto assets are deposited on the platforms which provide services in lending. These platforms are the middle agents during the transaction between lender and borrower. The lenders outsource their assets to the platform with a deciding interest percentage. The platform then lends the crypto to the borrower who in return pays the interest. To remain on the safe side the

platforms use the crypto assets in a form of proof-of-stake to repay the interests to the lender. The earning through the staking is completely owned by the platform with no share of both lender and borrower. The stability and truth worthiness of platforms are very important for lenders and borrowers. These are like saving accounts for the lenders with sufficiently better interest rates than the banks. The annual yield is varied from 3% to 8% on crypto assets and 10% to 17% on stable coins [68]. There are automated and manual platforms. In a manual platform, the lender takes a significant amount to get the interest while in automatic the whole process is done by the platform.

Lending cryptocurrencies are getting very popular worldwide. It has earned a new status in big business. Many companies are doing billions of dollars' worth of businesses with this technology. Fintech companies are taking full advantage of this innovation and playing their part as service providers. The services of traditional banking are delivered on fewer charges such as low fees on credit cards, loans, and various other services. Given the success of crypto financing, there are also drawbacks. The volatility of cryptocurrency is a crucial threat in crypto financing. This erratic valuation may result in a reduced rate of return. Bank deposits are covered by constitutional insurance in most industrialized countries, which ensures that your money will be reimbursed up to a certain level if the bank files for bankruptcy whereas deposits in crypto lending are not protected by any institutional insurance [69]. The risk of cyber-attacks makes crypto lending platforms more vulnerable.

3.4.3.3 Trading

Despite their newness, digital currencies have gained widespread market share and rapid growth. Numerous fund managers already started to incorporate crypto inside trading holdings because it is a decentralized industry, the crypto service is available 24 hours a day, seven days a week [70]. The fintech businesses are gathering funds and publicity for its robotic bitcoin trading bot, which aims to reduce the fear of losing out

while providing customers with a dividend. Intraday exchange rates often present traders with excellent profit chances, but they also carry a higher risk. Crypto trading is grouped into 2 categories:

- Technical trading
- Fundamental trading

Researchers discovered that 66 percent of research methodology is based on technical research, while 23 percent and 11 percent are centred around fundamental study and general study [71].

3.4.4 Remittance

Remittances are defined as incomes coming from a country where one has relocated to earn and send it to its home country. Such movements are categorized in official and unofficial contexts. Hawala and physical currency mobility are examples of unofficial transactions [72]. Banks are officially authorized for cross-border transactions. Affiliate banking is a long-term agreement amongst banking organizations that allows the bank to offer solutions in regions where they don't have a physical presence. Blockchain technology arose on the outskirts of the institutionalized economy and is frequently in opposition to it. Cryptocurrencies have advanced rapidly for economic growth and the systematization of remittances since their inception. They have formed a proper channel for cross-border transactions. One of the first and most interesting functionalities of cryptocurrency has been cross-border payments [73]. Cryptocurrency and DLTs guarantee unchangeable and public transactions logging, as well as instantaneous payments. Standardization transforms remittances to the equity that may be traded by collecting processing charges, commercializing consumer information, plus integrating such transaction channels further into complex monetary solutions.

BitPesa was the first application of blockchain technology used for cross-border services. BitPesa coordinates payments among two fiat currencies by coordinating transactions from the source currency to bitcoin and from bitcoin to the currency of the receiving country [74]. Abra is another example that is

recognized by the world bank, which uses peer-to-peer payments by combining the banks with cryptocurrency also eliminating any charges. Ripple, an American FinTech giant consistently committed to cross-border transfers, but it moved its attention from peer-to-peer to interbank transfers, intending to replace correspondent banking.

3.4.5 Smart Contracts

Industrial and commercial processes are being transformed by smart contract innovation. Smart contracts, which are integrated into blockchains, allow the negotiated provisions of arrangements to be executed autonomously without the assistance of an intermediary. In decentralized ledgers, smart contracts content is simply recorded and maintained. In fig. 7, an example of the transaction between a buyer and seller is explained using smart contracts. Many industries currently use smart contracts, including the corporate world, insurance companies, and the medical sector in terms of logging their patient's medical status [75]. DeFi solutions and decentralized applications with extensive smart contract characteristics can expand to billion active users and hundreds of millions of everyday operations with low service charges. A real-time Fintech example including smart contracts can be an agreement between a farmer and an insurance company. The insurance company is obliged to pay the farmer when a contract term is executed. The payment is automatically transferred to the designated cryptocurrency address. Ethereum is a decentralized framework that helps smart contracts to be fulfilled. The Internet of things greatly innovates with the help of smart contracts. Most current producers keep their IoT networks centralized. The hashes used for the software updating can be embedded on smart contracts which are shared over the entire network saving resources for the producers. Smart contracts may help to mitigate investment risk, minimize administration and operation charges, and enhance economic service quality. The protracted settling periods have harmed traditional stock markets. Smart contracts can reduce the settling time from twenty days to one week bringing more customer satisfaction [76]. Smart contracts provide essential system security. Cloud computing is one of its applications. In cloud computing, the data

is stored on the servers and the data is verified using a third party. If the third party gets attacked or compromised, then the data is easily breached. The fundamental idea behind smart contracts is to allow a user to request that 2 cloud hosts perform the same operation. Using the contracts, the probability of deceiving is reduced. Smart contracts are fast evolving, yet there are still a lot of obstacles to overcome.

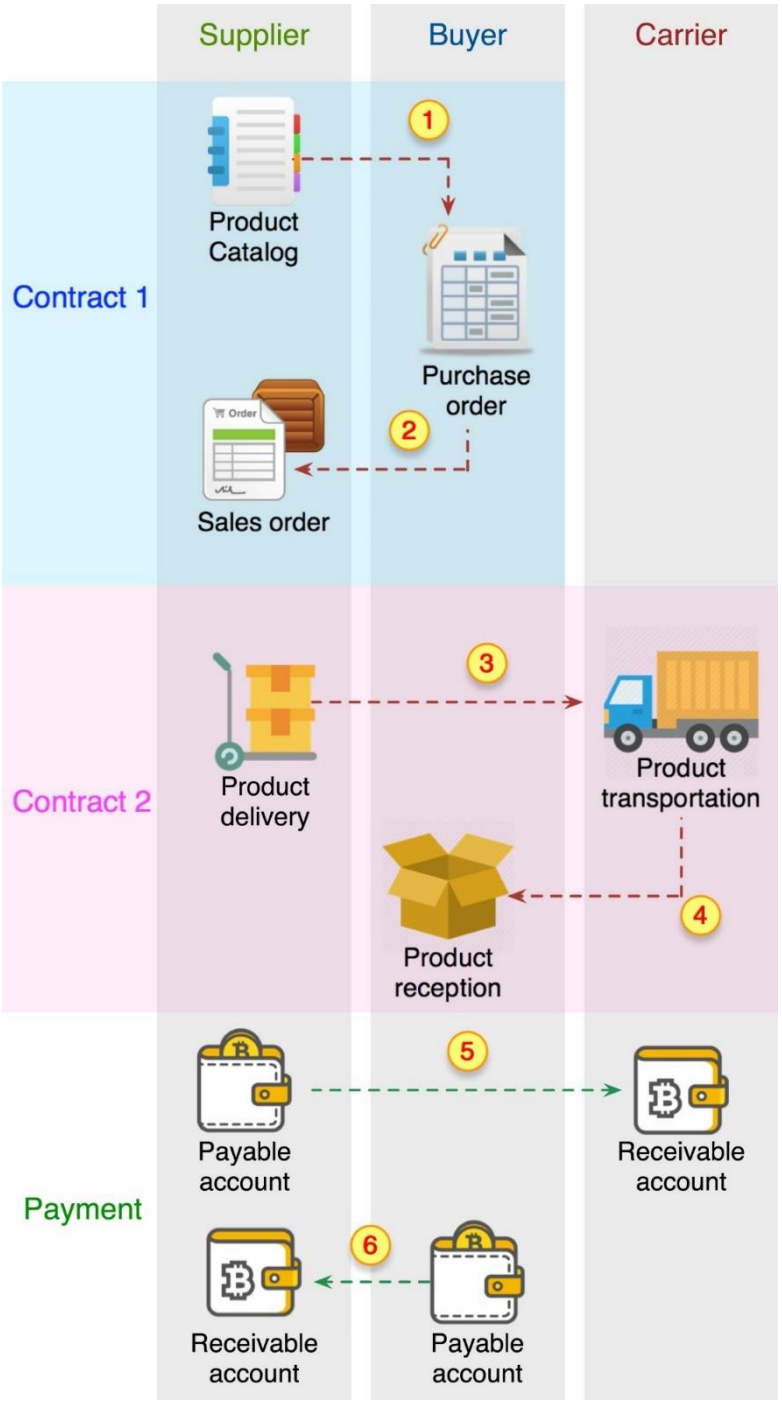

Figure 6 Smart Contract [95]

3.4.6 Know-Your-Customer (KYC)

Know your customer is a collection of standards used in the financial sector to verify clients and their economic personas. To authenticate the credentials of the users, blockchains depend on digital fingerprints. The establishment of a digital identity that integrates the distributed blockchain approach alongside proof of identity would serve as a digital fingerprint for each online operation. Identity authentication is at the heart of KYC, which serves as the foundation for financial organizations. KYC protocols will have to play a big part in attempting to combine valid identity control with confidentiality measures, particularly now that many fintech applications are being deployed on blockchains [77]. The identification check via an identity document, facial authentication, and documents authentication are the essential elements of KYC. Due to the combined dangers of monetary fraud and theft, institutions must concurrently adhere to several KYC rules while still preserving the privacy of customers. FinTech has created several viable options that cover both the legal and privacy demands of KYC while also encouraging convenience of access. All fintech, as well as a rising number of traditional banks, are transitioning to a digital system. KYC helps in checking the client's criminal status using modern artificial intelligence and authorizing banking access using mobile/portable devices. Along with its immense benefits the KYC still holds some drawbacks. The usage of digitization required quality hardware and software systems. There is a lack of maintenance and software up-gradation which affects the customer services.

3.5 Non-Fungible Tokens (NFT)

3.5.1 Technological Innovation

Non-fungible tokens or NFTs are one-of-a-kinds, unusual, and non-transferable virtual tokens which would be held on the blockchain network. These are not only jpegs that are recorded on the blockchains. This digital asset depicts actual elements such as artworks, songs, and movies. The most crucial aspect to remember is that these cannot be duplicated or reproduced at any expense. NFTs are becoming well-known as a great means to purchase and trade digital artwork.

After, November 2017, a whopping 174 million dollars was spent on NFTs [78]. The core technology is the blockchain and NFTs are relying on different blockchain platforms. The second generation of blockchains such as Ethereum was released enabling the programming and deployment of programs. The ERC-20 protocol was used for the transactions of fungible tokens like cryptocurrency. The NFTs are a new form of tokens, as these are non-fungible they are used on the ERC-721 protocol. The need for the development of this new protocol was to differentiate between non-fungible and fungible tokens [79]. NFTs have various business models. Artists now do not have to market their work through exhibitions or auction sites. Rather a creator can offer it as an NFT straight to the customer, allowing them to keep a larger portion of the profit. The artwork may not be the only approach to profit from NFTs. It enables businesses to try new business strategies, improve the value of existing products and services, and expand operations. They also provide new ways to participate in ventures as well as new opportunities for virtual trading. All significant industries, including large multimedia companies, will move into this sector.

3.5.2 Distinction between NFT and Cryptocurrency

In early 2021, NFT markets grew in popularity. While NFTs are exchanged using cryptocurrencies, they do have distinctive features that are vital to keeping in account when attempting to acknowledge them. NFTs are considered assets while cryptocurrencies have recognition of money. One of the distinguishing qualities of cryptocurrencies is their fungibility, or their interoperability whereas NFTs are non-fungible. The crypto is exchanged with equal value like one bitcoin for one bitcoin but NFTs is a unique identifier that prevents NFTs from being substituted for or compared to each other. Cryptocurrencies are inextricably linked to NFTs, and their pricing is influenced by them. The crypto markets are very volatile but NFTS concerning crypto is a bit stable. Table 1 elaborates on the volatility between them. Cryptocurrency substantial advances have been made tremendously in the past few years and are eligible to utilize what we have learned for NFT valuation [80].

	Bitcoin	Ether	Decentraland	CryptoPunks	Axie	from others
Bitcoin	50.30	33.60	10.11	4.73	1.26	49.70
Ether	30.70	45.38	13.69	5.77	4.46	54.62
Decentraland	13.57	12.75	66.88	2.49	4.32	33.12
CryptoPunks	7.61	10.79	6.59	70.83	4.18	29.17
Axie	5.44	3.43	9.20	0.49	81.46	18.54
to others	57.31	60.56	39.59	13.48	14.22	37.03

Table 1 Volatility between NFT and Crypto [80]

3.5.3 NFTs effect on Fintech and its Future

NFTs, smart contracts, and cryptocurrency are all innovative technologies supported by blockchain. The crypto sector has been impacted by the NFTs and now the FinTech sector is facing the effects of NFTs. NFTs could play an important role in the advancement of decentralized finance. Teller finance, the creator of an algorithmic creditworthiness system, has begun generating early liquidity for the framework via collected NFT [81]s. Non-fungible tokens allow existing crypto crowdfunding approaches, such as token IPOs, for fintech firms looking to engage within the crypto field or establish decentralized finance businesses. Fintech innovation will emerge from the mix of NFTs and DeFi. Mastercard, an American giant has entered the NFT industry, launching a sweepstakes campaign in which participants can win an NFT. Visa, another financial giant paid roughly $150,000 in ether crypto for purchasing of CryptoPunk which is a collection of hundreds of NFT virtual characters [82]. Visa's acquisition of one of the renowned CryptoPunk sends a powerful signal that conventional companies are paying close attention to blockchain-based technologies and seeking opportunities to profit from them. There has been a lot of benefits of using NFT technology, but it's come with some drawbacks. Whenever there is technology there is a chance of hacking which is the same happened in NFTs. One of the potential threats is money laundering.

Someone looking to evade taxes could purchase and create NFTs which he could upload on different platforms and perform the transactions using illegal money from numerous pseudonym accounts and legalize the money. All legal concerns can be figured out using comprehensive and strict usage of KYC.

3.6 Web 3.0

3.6.1 Evolution of Web 3.0

Web 3.0 refers to the world wide web's next generation, which encourages independent protocols and tries to lessen reliance on huge technology companies. In the beginning, the world was introduced by Web 1.0 which was a simple concept. Web 1.0 is only facilitated by reading the information and some basic writing. Web 2.0 was launched which is referred to as the read/write protocol. At first, the users were happy about the internet evolution but over a period the public became more knowledgeable about the way their data was used and how they were used as a product than using a product. Web 3.0 is referred to as the read/write/own era of the world wide web (www). Cryptocurrencies are used in Web 3.0 to signify ownership of distributed protocols. It enables the spread of collaborative frameworks for formerly centralized products [83]. The semantic web is the broad term for web 3.0. It is a real essence and an illustration of a web that leverages a database to change the web [84]. Blockchain technology and the modern web releases are driving the world toward dynamic web connections with AI. In figure 8 the transition from a centralized to a decentralized web is being elaborated. Google, a tech giant has launched its browser known as google chrome, but it is a centralized web that uses the users as a product instead of facilitating them. To cater to this issue a browser called brave is launched which is a true example of decentralization.

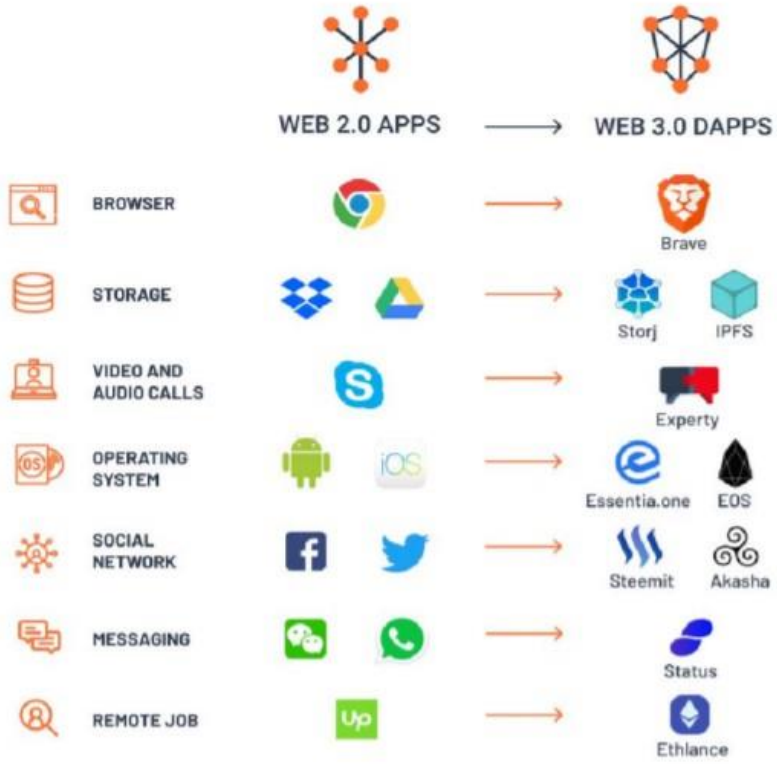

Figure 7 Centralized to Decentralized Web [84]

3.6.2 Web 3.0 and FinTech's

Web 3.0 implies a total overhaul of both internet and technology infrastructure. Engagement is accessible to anyone in a Web 3.0 decentralized environment and the larger the participants, the greater the everyone achieves. Before the 3rd phase, the internet should be completely implemented, companies must decide on the transformations that will surround it, else they would be incapable to meet customer expectations [85]. DeFi is a web 3 P2P network that allows the public to access financial services over a distributed blockchain platform. Web 3.0, which is focused on fintech, will usher in a wave of change. Financial and digital innovations have advanced at a tremendous speed, resulting in the emergence of new firms. Organizations are increasingly under pressure to reinvent their offerings and economic strategies to keep up with technological breakthroughs that can change the destiny of banking, settlements, and cryptos [86].

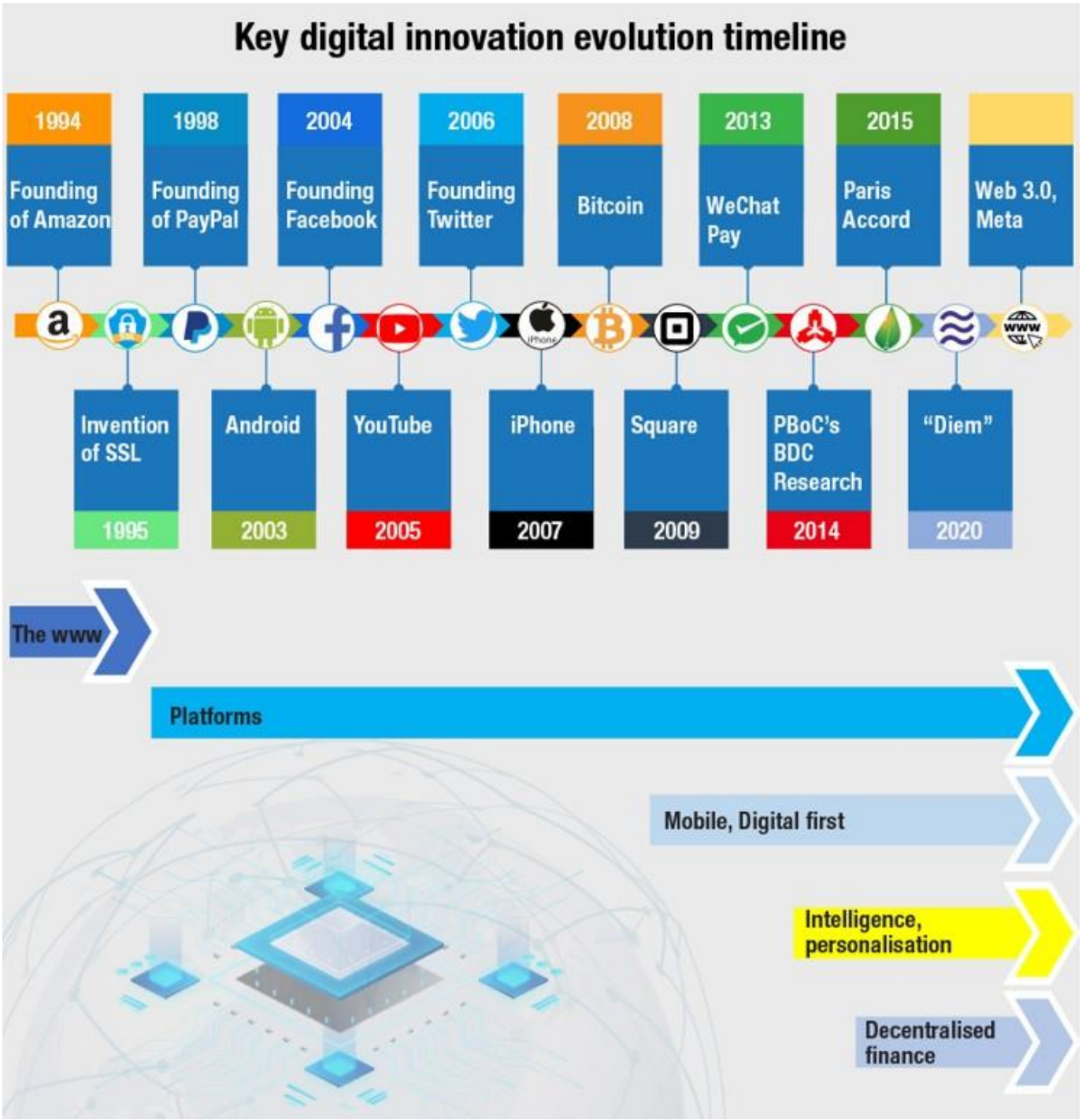

Figure 8 Timeline of key Digital Developments [86]

3.7 Metaverse

3.7.1 What is metaverse?

Metaverse is a hybrid of technology features such as virtual reality, augmented reality, and media in which people reside in a digital world. Web 3.0 will serve as the metaverse backbone. It will be made up of blockchain-supported dApps that will facilitate a user-owned cryptocurrency and data economy. In

1992, in science-fantasy fiction “Snow Crash”, writer Neal Stephenson is attributed with inventing the word “metaverse”, in which he imagined living avatars interacting in real 3D architecture as well as other VR scenarios [87]. The street, like every worldly place, is vulnerable to change. Developers can create their side streets that run into the main one. They can construct structures, recreation areas, signboards, and stuff which do not truly exist. Metaverse encompasses a wide range of activities, including games, gatherings, and leisure. To use Metaverse, users must put on a virtual reality headset before connecting to the VR dashboard [88]. It must be emphasized that in a variety of games and online environments, it is doable to possess and even exchange virtual things. Furthermore, the metaverse isn’t being constructed by a single organization or corporation. Separate groups will develop multiple virtual environments, which will eventually be compatible. The blockchain will confirm proof of possession of your digital items in both virtual realms if the two virtual realms are interconnected. Users can be able to acquire digital currencies for as long as they can access their cryptocurrency wallets [89].

3.7.2 Opportunity’s for FinTech’s with Metaverse

The virtual environment of the metaverse has spurred a passion among financial entrepreneurs to explore how financial technology and new financial solutions may deliver services in this completely new universe, just as it has in many other industries. The use of metaverse innovation to develop innovative business structures could pave the way for cryptocurrencies to become a huge rival financial system. Video calling tools were employed to link globally disparate personnel during the worldwide Covid outbreak, signalling the future of innovations. The most crucial metaverse according to experts, would be financial data administration and financial transactions handling that match actual life and are given by fintech services, making metaverse as necessary as the everyday world. Apart from online gaming, retail may be the most attractive aspect of the metaverse to the typical customer. Nowadays, businesses and merchants are attempting to encourage new types of customer contact inside the metaverse to sell more things, fintech companies are leveraging new financial demands, and

several entrepreneurs are developing new digital items based on characters. Banks need to work with fintech and benefit from fintech developments to establish a foothold in this emerging virtual environment of the metaverse. Financial companies and institutions in Korea have indeed started to build active virtual worlds for their customers [90]. Mastercard debuted an electronic medium that took users on a virtual visit of 3 distinct incentive packages. The Metaverse life platform was announced by eToro, a trading firm. This type of metaverse implementation can be utilized as a training system for financial industry personnel. This could be the most interesting opportunity in the financial era to become an entrepreneur since the innovations like blockchain, cryptocurrencies, NFTs, and metaverse will revolutionize the financial sector [91].

4. Discussions and Conclusions

Fintech has grown at a breakneck pace around the world, owing to shifting customer perceptions and attitudes, as well as technology advancements and legalization. Its future will be completely based on distributed technology. Fintech provides clients with more individualized services by enabling clients to do financial activities well over the cell phone, hence improving client service [28]. The growing number of consumers are more resilient to poor service quality, ambiguous terms, and conditions in their financial transactions. It is critical to acknowledge that these technological improvements that make our lives better also bring with them several concerns, like growing customer confidentiality and data security risks. Financial organizations use cloud services to attain high quality and effectiveness, but it also brings newer security threats. Many fintech firms around the world are collaborating for resolving blockchain adaptability, with the prospect of allowing customers to have ownership of their data and less dependence on intermediaries [92]. To grasp the future of this innovative technology different research has been done out of which one research utilizing Delphi approach was performed. Experts believe that blockchain technology would have a significant influence across numerous dimensions. Users, organizations, and nations will be able to trade value and information more freely, quickly, and efficiently by 2030. This emerging field could have a significant impact on the financial sector. Businesses will quite certainly have to transform their business strategies to account for the prospect of digitizing/tokenizing their assets [93]. A decentralized financial structure is being created using blockchain innovation which brings innovative methods for financial operations by respecting the boundaries of transparency and reliability.

Cryptocurrencies are playing a vital role in a decentralized structure. FinTech firms are working to find a solution to make the use of cryptocurrencies for peer-to-peer transactions by following the regulations. Although the current regulations are not feasible for cryptocurrencies but over time regulators are recognizing the benefits of this blockchain-based innovation. The world is leaning toward the digital infrastructure which brings innovations based on blockchain technology. Non-Fungible tokens are another example of blockchain innovation. The assets like artwork, music, videos can be produced digitally, and due to the DLT, the assets cannot be reproduced and redistributed. The Metaverse, known as a virtual world, is a replicated version of the real world. Using the virtual reality headset,

people can interact and perform their daily tasks. The covid-19 forced people to stay at home and perform many activities digitally which portrays the metaverse philosophy. Blockchain technology brought a disturbing environment for many conventional businesses. All these blockchain innovations are linked with cryptocurrency. Cryptocurrency is the only digital monetary system that allows cash movements in NFTs and Metaverse. The decentralized nature of blockchain has produced various real-time business models. The potential for blockchain solutions in the future is practically unlimited. As the blockchain boom starts to spread, financial institutions and fintech organizations will face new obstacles, and the firms which will integrate with the new technologies will have a strategic position in the market.

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