Blockchain - A Disruptive Technology in Financial Assets

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Abstract -- Blockchain as technology promises to be a hugely disruptive and empowering technology both in public and private finance applications. As a method to order transactions in a distributed ledger, blockchains offer a record of consensus with a cryptographic audit trail that can be maintained and validated by multiple nodes. It lets contracting parties dynamically track assets and agreements using a common protocol, thus streamlining and even completely collapsing many in-house and third-party verification processes. Block chain originally conceived as the basis of cryptocurrencies, aspects of blockchain technology have far-reaching potential in finance. Although it promises a secure distributed framework to facilitate sharing, exchanging, and the integration of information across all users and third parties, it is important for stakeholders to analyze it in depth for its suitability in business applications. There is a wide spectrum of blockchain applications ranging from cryptocurrency, financial services, risk management among others, however there is no comprehensive survey on the blockchain as disruptive technology in finance and its application, To fill this gap, we conduct a comprehensive survey on the blockchain technology, its challenges, advances in managing these challenges and the future of block chain technology in the financial industry.

Indexed Terms: Blockchain, Consensus Algorithms, Cryptocurrency, Finance

I. INTRODUCTION

Block chain is one of the most popular and controversial topics especially among technology leaders in finance today (Carlozo L.,2017). First things first, block chain is a digital ledger of financial transactions that is fully public, continuously updated by infinite users and considered by many impossible to interrupt, it is a continuous list of records in block as shown in fig 1.

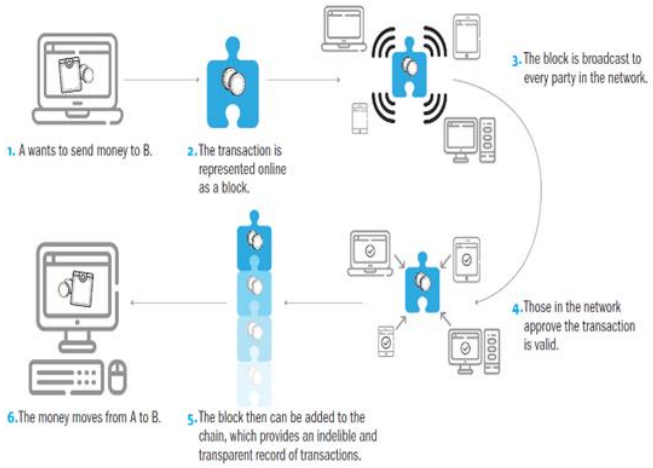

Fig 1 how block chain works.

A block chain database contains two types of records, transactions and blocks. Blocks hold batches of transaction. These blocks are time stamped and are linked to previous blocks and the transaction cannot be altered retroactively. Block chain can also record transactions automatically, these transaction value is measured in cryptocurrency that cannot be controlled by any party such as the central bank.

1.1 Principles underlying Block chain Technology

1. Distributed Database Each party on a blockchain has access to the entire database and its complete history. No single party controls the data or the information. Every party can verify the records of its transaction partners directly, without an intermediary (Liu and Li ,2017)
2. Peer-to-Peer Transmission Communication occurs directly between peers instead of through a central node. Each node stores and forwards information to all other nodes.
3. Transparency with Pseudosymmetry Every transaction and its associated value are visible to

anyone with access to the system. Each node, or user, on a blockchain has a unique 30-plus-character alphanumeric address that identifies it. Users can choose to remain anonymous or provide proof of their identity to others. Transactions occur between blockchain addresses.

4. Records Irreversibility. Once a transaction is entered in the database and the accounts are updated, the records cannot be altered, because they're linked to every transaction record that came before them (hence the term "chain"). Various computational algorithms and approaches are deployed to ensure that the recording on the database is permanent, chronologically ordered, and available to all others on the network.
5. Computational Logic. The digital nature of the ledger means that blockchain transactions can be tied to computational logic and in essence programmed. So users can set up algorithms and rules that automatically trigger transactions between nodes. According to john Callahan, the following are some of the reasons why financial executives should care about this buzz technology (Carlozo, L. (2017).

Blockchain is much more than bitcoin

Many people in finance departments mistake the mysterious and often volatile bitcoin for blockchain, they are two very different things. While invented to help transact in bitcoin, blockchain is the digital global ledger that not only records cryptocurrency transactions, but also provides a home for documents of all sorts. "Everything from property deeds, to birth records, to money such as bitcoin and various alt-coins resides on a blockchain backbone," said John Callahan, Ph.D., chief technology officer with Veridium, a company that specializes in advanced security technology. In fact, he described blockchain as "part of the iceberg beneath bitcoin."

Blockchain could reshape the business of recordkeeping, and business itself. According to Jon Raphael, CPA, chief innovation officer at Deloitte. "As scalable applications are deployed—and if they live up to their potential—blockchain will profoundly change how records are kept and transactions are processed. "Many finance executives are lagging behind their peers. A 2017 survey by Deloitte found that about 60% of big company executives said they were knowledgeable about blockchain. Blockchain is becoming a powerful way to do business. Because block chain allows for the transacting and securing of digital data, it is beginning to realize its potential to aid in a wide range of areas, from compliance to data Management. "It will bring enormous efficiency in business transactions besides making them military-grade secure," said Nitin Narkhede, vice president and head of block chain and innovation at Mphasis, a digital IT services company. "Hence, there is massive interest in experimenting with the technology and applying it in every business process."

II. BLOCK CHAIN TECHNOLOGY AND FINANCIAL SECTORS

The digital revolution has totally transformed the finance industry financial institutions use computers for databases as early as 1970s and 1980s, which was later migrated to portable devices, however this digital revolution has not yet revolutionized cross-border transactions.

Western Union, moneygram remains big names in cross border transactions. Banks continue to use a complex infrastructure for simple transactions, like sending money abroad. Blockchain technology allows financial institutions to create direct links between each other, avoiding correspondent banking for example Corda. Corda is a Distributed Ledger Technology (DLT).

In Corda's case, the circle is made up of banks who would use a shared ledger for transactions, contracts and important documents. In corda trust is they because a party must be known in order to join an existing a network as shown in figure 2.

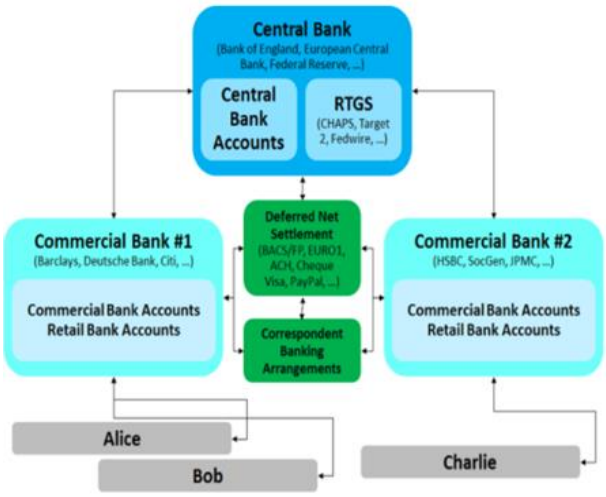

Fig 2 Distributed ledger Technology.

Competing financial institutions could use this common database to keep track of the execution, clearing and settlement of transactions without the need to involve any central database or management system. That is, the banks are able to formalize and secure digital relationships between themselves in ways they could nothave done before, therefore they cannot avoid the change brought by this technology.

From figure 2, the correspondent banking agreements and the RTGS could both be bypassed. Transactions can occur directly between two parties on a frictionless peer to peer(P2P) basis. Ripple, a permissioned blockchain, is built to solve many of these problems ((Liu and Li ,2017).

Digital Assets class

On the other end Bitcoin created something unique known as digital property. Before bitcoin, 'digital' was not synonymous with scarcity. Anything digital could be copied with the click of a button. An example is the music industry and album sales that supports this phenomenon. Bitcoin, however created uncopiable digital code. So, for the first time since bits and bytes were invented, there was a way to own something digital that couldn't be copied. This gave the digital code value. Upto date bitcoin's value is based on the capacity of its blockchain to prevent double-spending and the creation of counterfeit coins (Haya, Hasan and Salah,2018).With this in mind, bitcoin developers have pioneered coloured coins that can act as stock in a company. The 'color' of the coin represents information about what ownership rights the private cryptographic key provides as shown in figure 3

Figure 3: Coin colors

Another application, after receiving SEC (security exchange comission) permission, online retail giant Overstock announced it would issue public shares of company stock on its blockchain platform. This example is only one part of the story for blockchains in digital assets. They can be the asset, but blockchains can also be used to run the market itself. Basically, these financial efforts are treating digital assets as a bearer instrument, which is a wide and dexterous application.

Markets and Governance

Governance and markets, extends beyond just recording transactions. Nasdaq stock markets, for example, was one of the first to build a platform enabling private companies to issue and trade shares using a blockchain. Other developers are coding financial instruments that can be pre-programed to carry out corporate actions and business logic.

In 2016, a blockchain project called The Decentralized autonomous organization (DAO), running on the Ethereum blockchain (a secured decentralized platform for application that run exactly as programmed), was launched with the aim of emulating a crowdfunding market. Customer percentage of contribution to the fund represented the percentage vote determines the expenditure.

Regulatory reporting and compliance

Blockchains serves as a fully transparent and accessible system of record for regulators. The can also be coded to authorize transactions which comply with regulatory reporting.

For example, banks have severe reporting obligations to agencies such as FinCEN. Every single time they authorize a transaction of more than certain value say 10,000, they must report the information to FinCEN, that will store it for use as an anti-money laundering database.

Clearing and Settlement

The current process for clearing and settlement is wasteful and block chain tech is poised to change this, and the result is a net gain for all financial parties. With paper-world trading, the time frame for clearing and settlement of a transaction is generally referred to as 'T+3' – that is, three days after the trade (T), the transaction is settled. With blockchain technology, the entire lifecycle of a given trade – execution, clearing and settlement – occurs at the trade stage. With a digital asset, trade is settlement, and the cryptographic keys and digital ownership they control can lower post-trade latency and counterparty risk. Today buying and selling of securities happens in nanoseconds thanks to blockchain trading platform which eliminates middlemen in clearing houses and tremendous reduction in cost and friction.

Accounting and auditing

Accounting and auditing require a lot of true documentations, it is concerned with measuring rights and obligations over property or planning how best to allocate financial resources, for accountants using block chain provides clarity over ownership of assists and existence of obligation. By eliminating reconciliation and providing certainty over transaction history, block chain could also allow for increases in the scope of accounting. bringing more areas into consideration that are presently deemed too difficult and an unreliable to measure, such as the value of data that a company holds, Block chain is surely a replacement of bookkeeping and reconciliation work, this could threaten the work of accountants.

A block chain solution when combine with appropriate data analytics, could help with transaction level assertion involved in an audit and auditors' skills would be better spent.

III. ISSUES AND LIMITATIONS IN BLOCKCHAIN TECHNOLOGY

There are treacherous passes in any technological revolution. Many in blockchain industry have pointed out that blockchain has been overhyped, when the technology has limitations and may be inappropriate for many digital interactions. But through several research and development, success and failure, trial and error, many issues, challenges and limitations of blockchains have been realized they include: -

Complexity

Blockchain technology involves an entirely new vocabulary. It has made cryptography more mainstream, but the highly specialized industry is chock-full of jargon. For example, when it comes to chain, difficulty is a relative measure of how difficult it is to find a new block, the difficulty is adjusted periodically as a function of how hashing power has been deployed by the network of miners. Thankfully, there are several efforts at providing glossaries and indexes that are thorough and easy to understand in block chain.

Network size

Bloch chain relies on intensive computing power to run, miners use huge computer rigs with multiped network server to keep the network ticking over, this process is expensive, A study released by elite fixtures says that it cost more than $26,000 to mine one bitcoin in south Korea, which is one of the world largest markets for cryptocurrency trading. Another is issue is the cost of creating and maintaining the network. Amazon IBM and Microsoft are working on ways of improving cost and complexity in block chain networks by using cloud computing i.e. Block chain as a service where effective templates are offered to make it easy for developers to set up and run block chain networks. Blockchains are not so much resistant to bad actors as they are 'antifragile' – that is, they respond to

attacks and grow stronger. This requires a large network of users, however. If a blockchain is not a robust network with a widely distributed grid of nodes, it becomes more difficult to reap the full benefit.

Transaction costs, network speed

Bitcoin currently has notable transaction costs after being touted as 'near free' for the first few years of its existence. As of late 2016, it can only process about seven transactions per second, and each transaction costs about $0.20 and can only store 80 bytes of data. There's also the politically charged aspect of using the bitcoin blockchain, not for transactions, but as a store of information. This is the question of ''bloating' and is often frowned upon because it forces miners to perpetually reprocess and rerecord the information.

Human error effect

Firstly, block chain involves many parties from developers, speculators, users and even hackers. The effect of developer making a mistake when writing a code for blockchain application is common, for example the software bug of parity's wallet, while searching for bugs , a person accidentally become the owner of several wallets and disabled the code that could have saved this in attempt to reverse the error, the loss is estimated at $150-$300m .When it comes to users the alterability of blockchain is considered to serve protection against manipulative attempts, in our view this serves as an impediment because some actions demand reversible consequence. Consequently, education and training of both users and developers is important to reduce errors (Cannison, t ,2017). The Bithumb Hack block chain or human error to blame. On the other hand, blockchain is used as a database, the information going into the database needs to be of high quality. The data stored on a blockchain is not inherently trustworthy, so events need to be recorded accurately in the first place. The phrase 'garbage in, garbage out' holds true in a blockchain system of record, just as with a centralized database.

Block chain security

Block chain growth may impact or even crippled by security flaws, vulnerabilities remain a side note in distributed ledger technology. Block chain vulnerability include endpoint vulnerability which basically the spaces where human and blockchain meet, untested code under experimental on live blockchain. On the other hand, access to a blockchain requires both a Public key and private key. These keys are cryptic keys of characters of enough length to make the odds of guessing nearly impossible, this is both a strength and a weakness. Since hackers know that there is no use in trying to guess the keys , they focus a great deal of their time in trying to steal them, the best chance of obtaining keys is to attack the weakest point in the entire system e.g. the PC or a portable device, any block chain keys entered displayed or stored unencrypted on such devices can be used by hackers, it is unfortunate because most users make this easy for the hackers. The following ways can be used to prevent hackers from stealing block chain keys:

i Use a good antivirus
ii Run anti-malware scans regularly
iii Never state block chain keys in plain text
iv Use email blockchain wallet to send keys

There is one notable security flaw in bitcoin and other blockchains: if more than half of the computers working as nodes to service the network tell a lie, the lie will become the truth. This is called a '51% attack' and was highlighted by Satoshi Nakamoto when he launched bitcoin. For this reason, bitcoin mining pools are monitored closely by the community, ensuring no one unknowingly gains such network influence.

Lack of standards and regulations

According to Forbes one of the primary block chain security issues is lack of regulation and standards, bitcoin and cryptocurrencies wants to continue enjoying the anonymity that fuel the growth of blockchain while some government regulators and legacy financial institutions argue that even cryptocurrency must be regulated. The lack of standards protocol means that block chain developers cannot easily benefit from the mistakes of others, by each company, consortium operating in its own rules, the risk are high, further at some point, chains may need to be integrated. Lack of standardization can mean new security risks as diverse technology are

merged. Evolution in technology will ultimately bring about the following arrangement:

i Forced regulation and standards Self-imposed regulation and standardization
ii No regulation or standards for block chain built in house

Politics and Governments

Because blockchain protocols offer an opportunity to digitize governance models, and because miners are essentially forming another type of incentivized governance model, there have been ample opportunities for public disagreements between different community sectors.

These disagreements are a notable feature of the blockchain industry and are expressed most clearly around the question or event of 'forking' a blockchain, a process that involves updating the blockchain protocol when a majority of a blockchain's users have agreed to it.

These debates can be very technical, and sometimes heated, but are informative for those interested in the mixture of democracy, consensus and new opportunities for governance experimentation that blockchain technology is opening.

Why Use a Blockchain?

As the implications of the invention of blockchain have become understood, a certain hype has sprung up around it, this is, perhaps, because it is so easy to imagine high-level use cases. But, the technology has also been closely examined: millions of dollars have been spent researching blockchain technology over the past few years, and numerous tests for whether blockchain technology is appropriate in various scenarios have been conducted. Blockchain technology offers new tools for authentication and authorization in the digital world that preclude the need for many centralized administrators. As a result, it enables the creation of new digital relationships. By formalizing and securing new digital relationships, the blockchain revolution is posed to create the backbone of a layer of the internet for transactions and interactions of value (often called the 'Internet of Value', as opposed to the 'Internet of Information' which uses the client-server, accounts and master copy databases.

But, with all the talk of building the digital backbone of a new transactional layer to the internet, sometimes blockchains, private cryptographic keys and cryptocurrencies are simply not the right way to go. Many groups have created flowcharts to help a person or entity decide between a blockchain or master copy, client-server database. The following factors is a filter of much of what has been previously done:

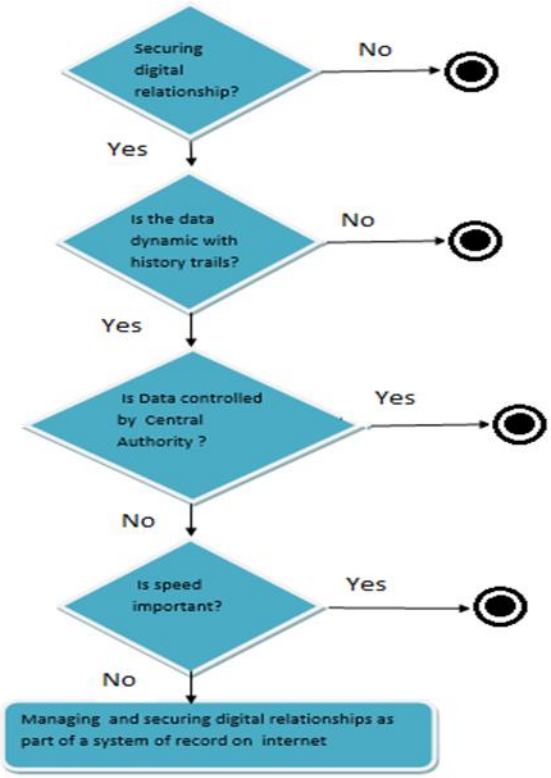

Fig 3: Filter Factors for Block chain adoption

Dynamic data with an auditable trail

Traditional Paper can be difficult to counterfeit because of the complexity of physical seals or appearances. So, if the data and its trails are important to the digital relationships and they are helping to establish, then blockchains is the best option as seen in the figure above.

Central authority control

There remain many reasons why a third party should oversee some authentications and authorizations most of the time is to regulate. There are times when third-party control is totally appropriate and desirable. If privacy of the data is the most important consideration, there are ways to secure data by not even connecting it to the internet. But if existing IT infrastructure featuring accounts and log-ins is not enough for the security of digital identity, then the problem might be solved by blockchain technology.

Private key cryptography enables push transactions, which don't require centralized systems and the elaborate accounts used to establish digital relationships. If this database requires millions of dollars to secure lightweight financial transactions, then there's a chance blockchains are the solution.

Transaction Speed

If high performance, millisecond transactions are what is required, then it's best to stick with a traditional-model centralized system. Blockchains as databases are slow and there is a cost to storing the data – the processing (or 'mining') of every block in a chain. Centralized data systems based on the client-server model are faster and less expensive.

In short, while we still don't know the full limits and possibilities of blockchains, we can at least say the use cases which have passed inspection have all been about managing and securing digital relationships as part of a system of record.

Distributed Consensus algorithms

Consensus can be explained as generally accepted agreement about an opinion or decision among a group of individuals (Nyberg, 2018).

Distributed Consensus

means that all nodes in the system use identical history of data to decide which ledger that represents the truth (Lokøy, 2018). Distributed consensus secure that everyone has the same truth, what I see is the same as what you see. There are two main types of consensus processes, permissioned or permission-less. In a permissioned consensus process, only selected entities are allowed participate, and opposite in a permission-less where anyone can contribute to the process.

Consensus algorithms

"A consensus algorithm is a process in computer science used to achieve agreement on a single data value among distributed processes or systems.

Consensus algorithms are designed to achieve reliability in a network involving multiple unreliable nodes." (Zheng, Z et al.,2017)).

There are many different consensus algorithms, the choice is often determent by the architecture of the blockchain; public, private or consortium. But they all have one main purpose "… ensures that the next block in a blockchain is the one and only version of the truth (Castor, 2017)." Since the consensus algorithms incentive, the users in the network to agree upon one version of the truth, it solves the double spending problem: On a blockchain the double spending problem is solved by publicly announcing the transaction to all miners in the blockchain such that all miners verify all transactions. (Hua and Notland, 2016). The different consensus algorithms all have there "pros and cons", some use vast amount of computational power and electricity, memory and computational time, while other algorithms use almost none, and the security level varies depending on how the blockchain network is set up. The most known type of consensus algorithm in relation to blockchain technology is proof of work, which is used in the cryptocurrency Bitcoin. "In proof of work, miners compete to add the next block (a set of transactions) in the chain by racing to solve an extremely difficult cryptographic puzzle..."(Castor, 2017). The "puzzle" is extremely difficult to solve, but at the same time, it is easy for the other nodes on the network to verify the solution (Blockchainhub, 2017). The miners invest electricity and special mining computers in processing the consensus algorithm proof of work. As a reward for solving the "puzzle", the miners get rewarded with lottery tickets. The bigger investment in electricity and computational power the more tickets for the lottery. The price in this lottery is new Bitcoins and transaction fees from recent transactions (bitcoin-dev and Blitzboom, 2017). Proof-of-work provides security to

the network. The cost to disrupt the network scales with the amount of computational power and electricity spent by all participants (Antonopoulos, 2017). You can´t hack the system unless you provide enough computational power to get consensus amongst more than 51% of the network, which means that you must simultaneously hack 51% of the computers in the network or provide more computational power. This makes the system more or less unhackable (Drescher, 2017).

IV. BLOCK CHAIN AS A DISRUPTIVE TECHNOLOGY

Disruption is an intersection between economic social and technological Domain figure 5, In order to explain if blockchain can be seen as a disruptive technology in Financial investments ,we will clarify the concept of disruptive innovation, by presenting the evolution of disruptive technology theory ,explain if blockchain is disruptive or not, and to subsequently explain the link between a disruptive technology and the effect it will have on business .

The term disruptive technology or innovation was introduced by Clayton Christensen in the article "Disruptive technologies: Catching the wave" (Bower and Christensen,1995), and has later been popularized through his works "The Innovator's Dilemma" (Christensen, 2016) and "The Innovators' Solution" (Christensen and Raynor, 2004). According to Yu and Hang (2010) the theory around disruptive innovation has its origin from Schumpeter in 1942, and have evolved through time, Figure 4. "Discontinuous innovation" was extensively used before academia embraced the term "disruptive technology." Even though the two terms are very similar, discontinuous is a weaker and less tangible qualifier than disruptive,

which might be a reason to why disruptive gained popularity within some fields.

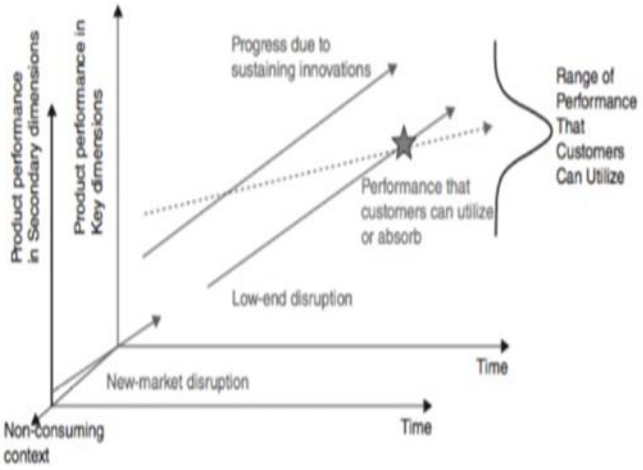

Fig 4: Disruptive Technology Theory (Yu and Hang, 2010)

Catching the Wave" Bower and Christensen (1995) state that when a market or technology is changing, a consisting pattern of failure appears for businesses to maintain their position at the top of their industry. Further, the authors discuss the difference between sustaining a disruptive technology. Sustaining technologies are seen as the markets expected evolution of a product that is already appreciated and in use. Disruptive technology however, introduces a very different set of attributes from the ones the mainstream customer historically value. A disruptive technology tends to perform significantly worse on one or two attributes that are important to the customers. Christensen et al. (2015) also introduces the terms low-end and new market footholds. Low-end footholds exist because incumbent companies have their focus on the most profitable and demanding costumers, thereby they pay less attention to the low-end market where a disruptive innovation can gain popularity. Newmarket footholds are as simple as it sounds, a new market that has not previously been attended to (Christensen et al., 2015). Products that do not seem to be relevant to customers today (disruptive technologies), might squarely address their needs tomorrow. To improve profitability and continue to be successful, management of the resource allocation process is pointed out as utterly important. Keeping resources focused on

innovations and needs that do not appear to be financially attractive today, might be the biggest challenge for managers. Established organizations struggle to face this challenge due to their existing business model. Smaller businesses and startup are agiler and have a quicker decision-making process, and they have inexpensive forays into the product and market. Companies that have used the strategy to bend/alter disruptive technology to fit their current customers, rather than to find a new market or customer segment for the technology, are according to history almost sure to fail. "Disruptive technology should be framed as a marketing challenge, not a technological one" (Christensen, 2016, page 173). Having reviewed these theories and models , Block chain is truly a disruptive techbology in Financial industry

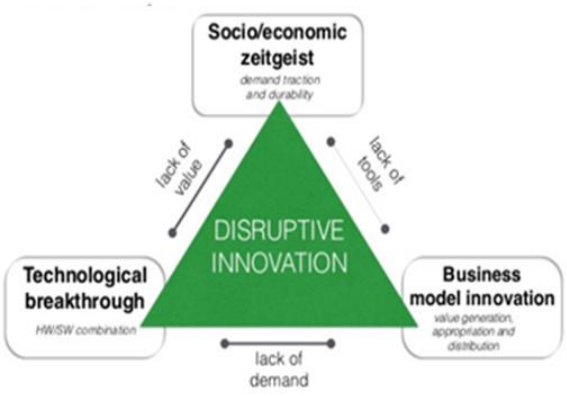

Figure 5: Disruptive innovation

V. CONCLUSION

Blockchain is highly appraised and endorsed for its decentralized infrastructure and peer to-peer nature. However, many researches about the blockchain are shielded by Bitcoin. But blockchain can be applied to a variety of fields far beyond Bitcoin. Blockchain has shown its potential for transforming traditional industry with its key characteristics: decentralization, persistency, anonymity and auditability. For block chain to become an integral part of a financial system, block chain must be developed, standardized and optimized, this process may take many years, but we have a strong believe that this is achievable. It is a disruptive technology and its future depends on collaboration among several financial institutions. Organization should not overreact to disruption by dismantling a profitable business they should strengthen relationship with core customers and at the same time create an opportunity that arises from the disruption. "Some disruptive technology succeeds some don't"

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