Blockchain & Distributed Ledger Technology: A game changer beyond cryptocurrencies...
HIGHLIGHTS

- Blockchain technology was conceived with the intention of creating a peer-to-peer, secure, and unregulated electronic cash system called bitcoin. Its underlying technology, however, quickly caught the attention of enthusiasts who started to explore its applications as an alternate system to store and exchange data, messages, and value, in addition to conducting transactions.

- Within the group of technological innovations applied to the financial services sector known as Fintech, Blockchain, or Distributed Ledger Technology, seems to have the potential to be the most disruptive. Some argue that it could have the most impact on record-keeping since the formalization of the double-entry bookkeeping system in the 15th century.

- A large part of the value of blockchain lies in its potential to streamline processes, eliminate frictions caused by the need for third parties to execute transactions, and to create a secure, immutable record of history.

- It is a mechanism to establish trust. Blockchain establishes digital “trust” among transacting parties by creating secure mechanisms for authentication and authorization. It facilitates direct peer-to-peer transactions and minimizes the need for intermediaries.

- Research efforts on the applications of this technology are being sponsored by both the private and public sectors. It promises to have far reaching effects on a multitude of industries including banking, financial services, supply chain management and logistics, and insurance to name just a few.
INTRODUCTION

Fintech, or financial technology, is the group of technological innovations applied to the financial services sector. As it stands today, it mainly revolves around three axis. The first is automated investment advisory services or robo-advisors. The second is crowdfunding and peer-to-peer platforms which connect lenders and borrowers directly bypassing traditional lenders such as commercial banks and other intermediaries. The third, which is the main topic of this discussion, is the applications of distributed ledger technologies (DLT), or blockchain, in the financial industry.

All three branches of Fintech have one thing in common: they use technology applied to the financial sector to directly connect end-users to the service providers bypassing the intermediary, which is usually a financial institution. Hence its disruptive nature to the financial services industry.

In light of the increasing attention Fintech is getting from investors, consumers, investment managers, and regulators, the CFA Institute conducted a Fintech global survey of its members and published the findings in the Fintech Survey Report in April 2016. The survey was part of an industry response to a request for comments on automated financial services by the Joint Committee of the European Supervisory Authorities (European Banking Authority, European Insurance and Occupational Pensions Authority, and European Securities and Market Authority).

Chart 1. Greatest Impact of Fintech on Financial Services Industry, by timeline (% of respondents)

One of the most relevant findings in the context of this note was that respondents believed that the most significant impact of Fintech on the financial service industry in the short term will be from the increased adoption of robo-advisors. The second most significant in the short term turned out to be from peer-to-peer lending platforms and Crowdfunding, which

Source: Fintech Survey Report April 2016 – CFA Institute®
combined constitute 48% of respondents. The most significant impact, however, over the medium term, 5 years from now, will be from the applications of Blockchain technology. So what is Blockchain and how is it expected to disrupt existing industries?

**BLOCKCHAIN & BITCOIN**

Blockchain was conceived in a white paper published by a person under the pseudonym Satoshi Nakamoto in 2008 titled “Bitcoin: A peer-to-peer electronic cash system”. The paper introduced the concept of Bitcoin as the world’s first peer-to-peer electronic cash system that is completely anonymous and free from government regulation. The blockchain is the database or ledger system on which Bitcoin lives. Think of it as the underlying operating system of Bitcoin.

Bitcoin is an unregulated digital currency which aims at bypassing government currency controls and facilitating electronic transactions by doing away with third-party intermediaries which it viewed as inefficiencies. Transactions using Bitcoin are stored, processed, verified, validated, and transferred using a peer-to-peer network that is open source, public, and anonymous. All of these processes are conducted over a distributed ledger system or what came to be known as Blockchain. Although the blockchain technology was developed solely to support bitcoin as a peer-to-peer unregulated digital currency, it is important to note that the below discussion will focus on the application of the technology underlying bitcoin and is not about cryptocurrencies.

It took years after the publication of the white paper before industry participants realized the potential uses of Blockchain in business and started tapping the technology and adapting it to be used in a multitude of applications. Blockchain, or distributed ledger technology, is a nascent database technology that some believe could have the most impact on record keeping since the formalization of the double-entry book-keeping towards the end of the 15th century. Luca Pacioli, an Italian mathematician who is often called the “father of accounting”, first published a detailed description of the double-entry book-keeping system in a book published in 1494 thus enabling others to study it and use it. It has since formed the backbone of the financial system through its standardized system of recording debits and credits.

**TRADITIONAL DATABASES**

The digitization of record keeping systems resulted in what we know today as a database. It is now the most common modern medium of record-keeping. It is basically a collection of data stored on a server coupled with a user interface that enables users to retrieve, store, amend, and update the data as needed. Such a database could be structured as a simple table that contains contact information such as a phone book, or unstructured and very complex containing for example all the financial records of a commercial bank or all the multimedia posts, likes, and profiles of all Facebook users. Moreover, a database could be either physically centralized, meaning that all users on the network need to access a central server...
where all the data is stored, or distributed. A distributed database is spread over multiple servers in multiple locations which makes it faster and more efficient than a centralized model.

One major disadvantage of the centralized model is that it represents a single point of failure. If the database goes out of commission for whatever reason, the entire network collapses. The distributed model solves part of this problem in having multiple databases that can be accessed by users and adds more efficiency and speed to data management and access process. In both cases, however, the database is built around a client-server interface and access rights of users have to be managed by a central authority.

Some users would have read-only access, some would be able add to the data, while others could have rights to add, delete, and amend data. A major risk with this database model is that someone could obtain access rights in an illicit manner and compromise the integrity of the database and its contents. A traditional database, be it centralized or distributed, has a host of other drawbacks from an operational perspective. Many of those drawbacks stem from the fact that at many points of a typical workflow human intervention is needed, mostly to review, verify, and authorize certain transactions. While access to a database is obtained through a gatekeeper, the transactions that are ultimately recorded onto a database environment almost invariably require a middleman or an intermediary of some sort.

Trusted intermediaries exist to facilitate a transaction and provide comfort to both sides of this transaction that the counterparty would fulfill its contractual obligations. Trust is the cornerstone on which any transaction is based. You need to have confidence that the goods you are buying are as per the specifications required and the buyer needs to trust that they will be paid in exchange for those goods. This concept of trust became especially important
with globalization where the need to conduct transactions with strangers from all over the world grew exponentially. The role of a trusted partner was assumed by middlemen who would guarantee both sides of the transaction. This is typically a bank that provides letters of credit to facilitate international trade or a clearing and settlement institution in the case of trading of financial securities.

Taking the example of securities trading, all the records of trading on a certain security as well as custody and settlement services, among others, are provided by trusted third parties, while the transacting parties only keep records of their own dealings in a certain security. In a way, it is those third parties that hold the “Truth” about this security. They have the records on the dealings on this security and are considered an authority on determining who owned how much of it and when. At the same time, a clearing and settlement institution, for example, represents a single point of failure. If the database of the clearing entity gets hacked or the data is lost or is compromised for any reason, the system would be disrupted.

The blockchain is a new type of database or record keeping system that could potentially solve many of the shortcomings of a traditional database, while offering numerous opportunities for change in the financial industry as well as in many others.

**BLOCKCHAIN BASICS**

![Chart 4. Centralized Ledger](chart4.png)

![Chart 5. Distributed Ledger - Blockchain](chart5.png)

*Source: NBK Capital*
Blockchain, or distributed ledger technology, works on principles that are fundamentally different from those of a centralized ledger or traditional database. In a distributed ledger architecture, there is no central authority and no “master copy” of the database. Instead copies of the same database are replicated on all the computers that make up the network and are referred to as “nodes”. Records are added after being approved by the majority of network participants through a consensus mechanism that makes it extremely hard to change historical data, if at all. New information is encrypted and packaged in a new block and added to the chain. Each new block is dependent on the one before it and therefore history is preserved and cannot be tampered with without such action being detected. Hence the immutability characteristic of blockchain.

Chart 6. Example of a Typical Blockchain

The main attributes of blockchain, which are immutability, security and speed, make it a platform that is well suited for storing and protecting critical data and for tracking high-value physical and digital assets’ ownership and provenance. The blockchain’s immutability, which means that historical records are permanent and cannot be changed, makes it an extremely reliable source of “Truth” providing a very solid source of assurance on the authenticity of the data.

If a network participant wants to add a transaction to the Blockchain, the transaction information is broadcasted to all the participants. It could be a transfer of funds, transfer of ownership title of a physical or a digital asset, or a simple change of database record such as the person’s own phone number in a phone book. Participants would first check if the initiator of the transaction owns the asset in case of an asset transfer, has enough funds to cover the transfer amount, or, in the case of the phone book, that this person is the actual owner of the phone number. If the majority of participants, or nodes, agree on the transaction based on predetermined algorithms, the transaction is permitted.

Many transactions occur on the network at the same time. The transactions that occur within the same time period are bundled together in a block that has a unique identification number, timestamp, and a reference to the previous block. This block is then placed on the network
for the participants to verify that the transactions it contains are legitimate. This is the consensus mechanism that insures that 51% of the network participants agree on the legitimacy of the block. There are many consensus mechanism employed by different variations of networks. The one used by the Bitcoin network, which is an open network, is a “proof-of-work” mechanism also known as “mining”.

A “proof-of-work” mechanism involves solving a complex cryptographic computation or a mathematical puzzle which requires the allocation of significant resources in terms of time and computing power. While solving such a puzzle is very difficult and time consuming, verifying the solution is relatively easy. When a “miner” is the first to solve the cryptographic problem, the result is announced to the network participants who verify it and the new block is added at the front of the blockchain.

The two most important parts of a block in a blockchain are its header and its contents sections. The header contains identification data, known as metadata, such as the block’s reference number, a timestamp and the reference number of the previous block. The contents section usually contains a list of transactions including the addresses of the transacting parties and the amounts of the transactions, digital assets, ownership or identity information, instruction statements or even executable programing code.

Since each block has a reference to the block preceding it, it is possible to trace transactions all the way back to the genesis block (or block 0) and thus one can obtain a complete ownership history of an asset for example, making it a transparent, verifiable, and fully auditable database. Any attempt to change a historical block will result in automatically invalidating the subsequent blocks, hence the immutability of the blockchain. Technically, to change a previously mined or verified block and all of its successors, one has to have more computing power than the majority of the nodes on the network, which makes it an extremely low probability event. Changes have to be made through adding a new transaction to the chain that would correct a historical record while preserving the erroneous one. Therefore, as the blockchain grows longer, it becomes increasingly difficult for outsiders to tamper with the data making it progressively robust and secure.

**ESTABLISHING TRUST – PUBLIC AND PRIVATE PERMITIONED NETWORKS**

Trust is the core of any transaction and without some mechanism to establish it between the transacting parties, dealing becomes impossible. In a digital world “trust” could simply be established by two things: authentication and authorization.

Authentication is making sure that the counterparty you are dealing with is whoever they say they are. In other words, it is a mechanism to prove identity. While in the physical world this could mean an endless trail of paperwork, stamps, and KYCs, in the digital world, and especially on the blockchain, authorization is achieved by private key cryptography. In a bitcoin transaction, only the holders of a private key can release funds for their accounts. It is a very strong tool to establish identity as it saves individuals and entities from sharing too
much information about themselves with multiple parties to be able to prove their identities when such information could be used fraudulently.

The second leg of establishing trust in the digital world is authorization. Continuing with the bitcoin transfer example, a distributed ledger makes sure that the person transferring the funds actually has enough funds, i.e. bitcoins, to cover the transfer amount through an almost real-time record keeping mechanism. Authorization is achieved through a consensus mechanism which ensures that the majority of network participants agree on its current status, i.e. the ledger balances in this case.

The description above is largely applicable to public or open networks, also known as permission-less networks such as the one used by bitcoin. In this type of network, protecting the integrity of the data and establishing “trust” is achieved through mechanisms such as “proof-of-work” which require a significant amount of computational work performed by powerful computers, i.e. mining. In the case of bitcoin, miners are being rewarded by an ever decreasing amount of bitcoin which could eventually be replaced by a simple transaction fee. This process consumes vast amounts of energy resources due to the computational power involved and is relatively slow as currently one block could be added to the bitcoin blockchain every 10 minutes.

Blockchain networks could be also designed as private networks that would serve a group of institutions with a common purpose, business interest, or project. In this case “Trust” protocols are established a priori as the participants are known to each other in advance. The permissioning mechanism is well documented and known to all, thus eliminating the need for mathematical computation, or proof-of-work, for authentication. Private distributed ledgers are far less complex than public blockchains and are much faster.

A combination of both types is also possible whereby some parts of the network are made public for everyone to view and audit, where other parts are controlled by certain parties who have the authority to add blocks to the distributed ledger.

Beyond Bitcoin and other similar cryptocurrencies, the value of the distributed ledger technology is becoming increasingly apparent and its applications in business transactions and record-keeping are slowly beginning to be adopted by start-ups and established conglomerates alike.

**USE CASES OF DISTRIBUTED LEDGER TECHNOLOGY**

The term blockchain has been closely linked to cryptocurrencies, so much so that bitcoin and blockchain have been used interchangeably. The fact of the matter is, even though blockchain is the technology underpinning bitcoin, it is the concept and the architecture of distributed ledger technology (DLT) that are being explored, researched, and piloted by numerous institutions in the financial industry and beyond. Blockchain is the enabling technology for bitcoin and could very well be used to build other applications, the same way a traditional
database could be used to store the financials of a very large banking conglomerate or simply be used as a phone book.

According to Espacenet, an online database that tracks global patent filings, there were 36 blockchain-related patent filings in January 2017. In a sign of the interest the technology and its promise, a search in mid-March 2018 yielded around 537 filings! This represents only the portion of filings that have been made public so far as the US patent office must release patent information 18 months after they are filed. MasterCard, for instance, has filed 15 patents around consensus mechanisms for permissioned blockchains and other payment systems related processes.

Going back to the findings of the Fintech Survey Report conducted by the CFA Institute, a question was asked on the perceived impact of blockchain technology on various branches of financial services. On a scale of 1 to 7, with 1 meaning “no impact at all” and 7 meaning “significant impact”, Clearing & Settlement topped the list with 48% of respondents rating the impact at 6 and 7. It is followed by Alternative Currencies and Commercial Banking at 46% and 41% respectively. Asset Servicing and Fund Administration were thought to be significantly impacted by 33% and 31% of the respondents. The results of this section of the survey are presented below in chart 7.

**Chart 7. What impact, if any, will blockchain technology have on the following aspects of financial services?**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>1- no impact at all</th>
<th>2 &amp; 3</th>
<th>4 &amp; 5</th>
<th>6 &amp; 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing &amp; Settlement</td>
<td>48%</td>
<td>38%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Alternative Currencies</td>
<td>46%</td>
<td>39%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Commercial Banking</td>
<td>41%</td>
<td>46%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Fund Administration</td>
<td>33%</td>
<td>45%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Asset Servicing</td>
<td>31%</td>
<td>47%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Capital Market Infrastructure</td>
<td>26%</td>
<td>52%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Other Banking</td>
<td>24%</td>
<td>48%</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>Asset Management</td>
<td>13%</td>
<td>51%</td>
<td>37%</td>
<td></td>
</tr>
<tr>
<td>Real Estate</td>
<td>9%</td>
<td>43%</td>
<td>48%</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Fintech Survey Report April 2016 – CFA Institute*

What started as an operating system for a peer-to-peer digital currency and payment system has evolved into a technology that is promising to change the global financial system as well as many other industries that deal with physical assets including global shipping, diamond mining and trading, and expensive art. Basically any business that is concerned about provenance, transparency, copyright, ownership history, valuation and authenticity to name
a few. Next are a few examples of the applications and use case in financial services, smart contracts, supply chain management, and others.

**Financial Services**

Financial Services is one of the most promising areas in which blockchain technology is poised to make a disruptive impact. The global financial system has been dealing with inefficiencies and built-in risks such as frictions in conducting transactions and interoperability issues of the various systems used both within and across financial institutions. Today one can trade a stock in microseconds but needs three days to settle the trade. From credit checks and sanction lists that have to be continuously maintained and updated, to AML compliance and KYC forms, to dealing with correspondent banks and nostro accounts. The list goes on and on and each item on the list adds an extra layer to the cost of conducting business. Moreover, third party service providers such as SWIFT for interbank messaging and money transfers, CLS in the US for clearing FX trades, and many of the clearing houses that are used for equities transactions have all become monopolies in their respective markets which adds to the inefficiencies and the costs of doing business.

Distributed ledger technology and its power to facilitate peer-to-peer transactions and payments, identity management and authentication, and authorization mechanisms holds a lot of promise to transform the financial services industry.

Among the most comprehensive initiatives to conduct research and development on the applications of distributed ledger technology in the financial system is the R3 consortium. R3 is a start-up that was launched in September 2015 and is headquartered in New York. As per its website, “R3 is an enterprise software firm working with over 100 banks, financial institutions, regulators, trade associations, professional services firms and technology companies to develop Corda, our distributed ledger platform designed specifically for financial services.”

Participants in the consortium are hoping that the distributed ledger technology would reduce the cost and complexity of multiparty global financial transactions such as international payments and securities settlement. Corda, the flagship software platform that is being developed by R3, is an open source software platform that uses blockchain technology and smart contracts to allow network participants to streamline business operations while reducing transaction and record-keeping cost. The platform is an interoperable, open network that allows organizations to collaborate and transfer value directly without the need for third party in a way that is safe and fast.

In May 2017, R3 managed to raise USD 107 million of financing from 40 investors in 15 countries including Intel, HSBC, and Bank of America Merrill Lynch (BoAML) and Temasek. The members of this consortium have three tiers of investments available. The first is open to all investors, the second has a higher minimum but gives investors governance responsibilities such as sitting on certain committees, while the third tier requires the largest investment but comes with a board seat. SBI Group, BoAML, HSBC, Intel and Temasek are among third tier
investors. Other investors include ING Groep NV, Banco Bradesco SA, Natixis SA, Barclays Plc, UBS Group AG, and Wells Fargo & Co according to Reuters.

**Smart Contracts**

Blocks on a distributed ledger can store various kinds of data including executable code that could automate messages using “if statements” and other programing logic. Such code snippets could encapsulate the terms of a business agreement that would be executed automatically when certain conditions are met. When uploaded to the blockchain these code snippets are referred to as “smart contracts”. On the most basic level, smart contracts could perform simple calculations such as interest rate, or store information such as membership records, or send transaction execution instructions such as fund transfers.

Smart contracts are autonomous, meaning that they self-execute if and when certain conditions are met without the intervention of a third party. Documents are encrypted on a shared ledger for all parties to access and are redundant as they are replicated on all nodes of the blockchain and thus cannot be lost. This encryption makes them also very secure and makes it extremely difficult for hackers to gain access to them. Speed of execution is another attribute as they self-execute saving time and money since they don’t require any third party to administer them. They are also precise as they execute the exact code that is programed into them ensuring zero execution errors. This makes them one of the most exciting and promising applications of blockchain.

For example, in automotive insurance a claim process could be triggered as soon as an accident is reported. Once the details of the damage assessment and other variables are recorded into the blockchain, the smart contract would be automatically executed and the insurance claim paid. Another use case is in distribution and protection of copyrighted digital media such as photos or music. A photographer would publish ownership information on the blockchain along with a smart contract detailing the use policies and fees. Whenever the media is used, royalties will be automatically transferred from the user to the owner in a secure and transparent way while preserving the record of ownership.

Smart contracts offer a high level of transparency and reduce third party cost while minimizing, or even eliminating, conflict and disputes among counterparties. Smart contracts help exchange money, property, shares or anything of value, digital or physical, in a transparent, conflict-free way. Any legal agreement could be transformed into a smart contract if its terms could be coded. This has the potential to have a profound impact on many industries like banking, financial services, insurance and healthcare.

**Supply Chain Management**

Any type of information could be attached to a block in the blockchain. Land registration is one example as an increasing number of countries started testing the technology to automate and digitize parts of their land registries including Sweden, Georgia, and Ukraine. Land
information including main characteristics such as plot number, address, size, could be recorded in the content section of a block in addition to history of ownership and transaction details.

Another example is the use of the blockchain in the diamond trade industry. De Beers, the world’s largest diamond producer, announced in January 2018 that it is aiming to launch an industry-wide blockchain with the goal of tracking diamonds traded across the mining supply chain, from the moments they are mined and while changing hands in world markets. The objective being to assure buyers that the diamonds are authentic and are legally mined and above all, that they were not mined in conflict zones or used to finance conflicts.

“It’s a huge public ledger as immutable as anything invented. It’s a much more unhackable system than anything on a single server” ...

“...It has the ability to be very significant for the industry, and it could reassure banks financing the industry and would make the mining supply chain more efficient and transparent” - De Beers CEO, Bruce Cleaver – January 16, 2018

Another company, Everledger, a startup founded in 2015, tracks and protects valuable assets, such as diamonds and art works, by collecting an asset defining characteristics, history and ownership, with the aim of creating a permanent record on the blockchain. These records are available for use by stakeholders and industry participants to verify provenance and authenticity. Everledger says that it has already logged more than one million diamonds into its blockchain platform.

In the preceding cases, a combination of public and permissioned ledgers would allow all the network participants to have viewing accessibility to the provenance of the diamond, while at the same time controlling access to private and confidential information for permissioned users only.

More recently, on 16 February 2018, Maersk and IBM announced a joint venture aimed at improving global trade and digitizing supply chains using blockchain technology. The complexity of the global shipping network, the multiple parties involved and their disparate geographic locations and multiple languages makes for an ideal setting to implement a solution based on distributed ledger technology. As per Maersk and IBM joint press release, the new venture will initially commercialize two core capabilities. The first is a shipping information pipeline, which will provide end-to-end supply chain visibility enabling all parties involved in managing the supply chain to have real time, secure, and seamless information exchange about shipment events. The second is paperless trade, which will digitize and automate paperwork filings, enabling end-users to securely submit, validate, and approve documents using blockchain-based smart contracts.
Other Uses

The above are just a few examples of some of the use cases that are being currently researched and developed and where blockchain can make a difference. The use of this nascent technology could extend far beyond finance and supply chain management into numerous other industries including trade finance, healthcare, insurance, and government functions in addition to areas that could have a direct impact on the average consumer.

The retail industry, for instance, could arguably cut anywhere between 2% to 3% of friction in transaction costs by using a blockchain based peer-to-peer payment system. This would effectively reduce the size of needed margins for retailers and subsequently reduce end-user retail costs.

Remittances have notoriously high transaction costs that are generally borne by underbanked individuals who don’t have access to the conventional banking system. In the United States alone, it is estimated that around 7% of households representing 15.6 million adults are unbanked, while 20% of households (51.1 million adults) are underbanked according to a 2015 survey by the FDIC (Federal Deposit Insurance Company). In other less developed countries this number should be significantly higher. A smart phone and a digital wallet would constitute a very economical way to reduce these numbers.

Micropayments, which is prohibitively expensive in terms of transaction cost relative to transaction amount, is another potential use for the blockchain technology. Many online content providers rely heavily on ads as their main source of revenue. Through micropayments that are based on a blockchain infrastructure and a digital currency, users would be able to pay the equivalent of a fraction of a cent per visit in exchange for access. This way online content providers would be able to reduce their reliance on ad revenues and provide consumer with a safer, cleaner and more secure internet experience.
**WHAT’S NEXT?**

Much like any other innovation, especially in the field of information technology, distributed ledger and blockchain-based applications would need to go through a long process of evolution before maturing into a mainstream, widely adopted technology.

The industry is still transitioning from the proof of concept stage into early adoption. At this junction of development entrepreneurs will be the main drivers of innovation. Early adopters will start implementing the technology on a limited basis on parts of their processes and workflows, as we’ve seen with the likes of De Beers, Maersk, IBM, and the R3 consortium. Once those attempts prove successful, wider adoption will follow with the implementation of global protocols and standards.

The blockchain technology started as an operating system for Bitcoin. It has since been used on its own as an ecosystems for various applications and for the development of hundreds of other so-called cryptocurrencies. Regardless what the future of cryptocurrencies will look like, one thing looks increasingly certain; the interest in the underlying ecosystem, i.e. blockchain-based technologies, is picking up fast and private institutions, regulators, central banks and governments from around the world are committing serious funding to the research and development of its applications in various industries.
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