Chapter 10

Blockchain: The Next Breakthrough in the Rapid Progress of AI

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"Distributed ledgers, also known as blockchains, could be the most consequential development in information technology since the internet. Created to support the Bitcoin digital currency, the blockchain is actually something deeper: A novel solution to the age-old human problem of trust."

Prof. Kevin Werbach, University of Pennsylvania, Wharton School.

"By far the greatest danger of Artificial Intelligence is that people conclude too early that they understand it."

Eliezer Yudkowsky, an AI theorist.

Abstract

Blockchain technologies, once used exclusively for buying and selling bitcoins, have entered the mainstream of computer applications, fundamentally changing the way Internet transactions can be implemented by ascertaining ***trust*** between unknown parties. In addition, they ensure ***immutability*** (once information is entered it cannot be modified) and enable ***disintermediation*** (as trust is assured, no third party is required to verify transactions). These advantages can produce disruptive changes when properly exploited, inspiring a large number of applications. These applications are forming the backbone of what can be called the Internet of Value, bound to bring as significant changes as those brought over the last 20 years by the traditional Internet. This chapter investigates blockchain and the technologies behind it and explains their technological might and outstanding potential, not only for transactions but also as distributed databases. It also discusses its future prospects and the disruptive changes it promises to bring, while also considering the challenges that would need to be overcome for its widespread adoption. Finally, the chapter considers combining blockchain with Artificial Intelligence (AI) and discusses the revolutionary changes that would result by rapidly advancing the AI field.

Keywords: blockchain applications, AI applications, combining blockchain and AI, disruptive technologies, smart contracts, DAO, decentralized storage, IoT, internet of value, decentralized cloud storage, supply chain operations, blockchain/AI startups

1. Introduction

In a large IBM survey recently conducted by top executives on blockchain [1] it was found that one-third of the almost 3000 who participated responded that they are using, or considering adopting blockchain in their business. According to the survey, 8 in 10 of those exploring blockchain are investing either in response to financial shifts in their industry, or for the opportunity to develop entirely new business models. The results of the survey echo a recent article in ***Forbes*** [2] entitled *"Blockchain As Blockbuster: Still Too Soon To Tell, But Get Ready"*. The proponents of blockchain talk about its great potential capable of creating the same type of fundamental changes as those brought over the last two decades by the traditional Internet. Yet for the majority of people, including the two-thirds of executives in IBM's survey, blockchain remains an elusive concept, with its advantages not well understood by business people, government officials and the general public (the same thing was true with the Internet in the early 1990s). It is important, therefore, to explain blockchain and its unique advantages as well as its possible drawbacks and in particular the revolutionary changes that would result by integrating it with AI.

The purpose of this chapter is to investigate blockchain and the technologies behind it and explain its might and outstanding potential. It consists of three parts. The first part describes blockchain's achievements and expands on its ability to transform peer-to-peer collaboration by, among its other benefits, removing the need for trusted intermediaries. The second part looks at its future prospects, including its utilization as a distributed ledger and the disruptive changes it will bring while also considering the challenges that would need to be overcome, including the fear of hacking and the possible fraud associated with the utilization of the technology. The final part considers combining blockchain and AI and the breakthrough applications that could result from such a marriage. There is also a concluding section summarizing the chapter and suggesting some directions for future work.

2. The uniqueness of blockchain: decentralized, authenticated and immutable information at lower costs

Blockchain is simply a decentralized, or distributed ledger (versus the centralized ones kept by, say, banks to record transactions and keep customer balances) of trustworthy digital records shared by a network of participants. As such, it expands the traditional Internet of information and communications (emails, sending/receiving/searching for information, exchanging files, participating in social media, etc.) to a new category that can be called the "Internet of Value". Such Internet includes sending/receiving money between two parties without the need for financial intermediaries, buying and selling stocks, keeping/issuing certificates, including real estate titles, creating/executing smart contacts, improving supply chains, etc. Blockchain's uniqueness comes from the following capabilities:

- ***Trust:*** new information can be added only when the majority of computers in the network give their approval after satisfactory proof is provided that the information, which is transmitted cryptographically, is truthful. The authentication of information is done in short intervals of time and the updated information is stored (appended) to all participating network computers.

- **Immutability and transparency***:* information can be appended only to previous data and, once entered, cannot be changed, modified or lost, providing a permanent, incorruptible historical record that stays in the system permanently. Moreover, changes to public blockchains can be seen by all parties in the network thus ensuring transparency.
- **Disintermediation***:* the ledger (database) is not maintained by any single person, company or government but by all participating computers located around the world. This means that two parties are able to generate an exchange without the need for a trusted intermediary to authenticate the transactions or verify the records.
- ***Lower costs and greater speeds:*** lower transaction costs and greater speed are also characteristics of blockchain in a good number of applications by removing the monopolistic power of powerful intermediaries (e.g. banks) or large, centralized industry leaders (e.g. Airbnb).

3. Why blockchain is a disruptive technology

Blockchain provides a fundamental shift from the Internet of information/communications to the Internet of Value. The difference between the two is fundamental. The first disrupted business models in the 2000s and created the likes of Amazon, Google, Facebook, Alibaba as well as Uber and Airbnb. Its disadvantage is that the information transmitted can be copied, thus making it impossible to guarantee its trustworthiness without the approval of an intermediary, for example, a bank verifying that the money being transmitted is available. The biggest advantage of the Internet of Value is the establishment of trust, through the application of blockchain technology, between strangers who can now trust each other. This means assets can be exchanged in an instant and efficient manner **without** intermediaries who are no longer needed as trust is built into the system. Such an advantage of the Internet of Value is bound to cause even more profound changes than those brought by the Internet of information. Trusted peer-to-peer transactions will encourage the formation of decentralized structures, diminishing the monopolistic power of intermediaries such as banks or firms like Uber and Airbnb [3]. This will be done through the creation of new players that would exploit the blockchain-based platforms of decentralized networks with the potential to dramatically narrow the monopolistic power of today’s dominant actors, democratizing the global economy and creating a more efficient and sustainable economic system [3].

Blockchain applications started slowly introducing bitcoins after Nakamoto’s 2008 paper and were restricted to cryptocurrencies until July 2015 when the Ethereum platform was released, allowing the issuing of smart contracts. At around the same time Estonia started implementing blockchain technologies in its governmental operations, including an ehealth record system that covered any one of its citizens who had ever visited a doctor. Further applications were introduced in 2016 with smart contracts and decentralized autonomous organizations (DAOs) with huge potential thus fundamentally affecting the legal profession and the management of organizations (see below). However, the most significant applications are taking place since

2016 with a large number of startups working on innovative solutions that are going to change the economic landscape [4] and turn blockchain into a momentous technological force.

3.1. Achievements

Apple, Google, Amazon, Facebook, Tencent, Alibaba, Samsung, Netflix, Baidu and Uber (with a combined market surpassing $4.3 trillion at the beginning of 2018) were created by exploiting the advantages provided by the evolving Internet of the late 1990s and the 2000s until now. These eight firms disrupted the economy and business sector by revolutionizing shopping and viewing habits, the search for information and advertising spending, among others, in ways no one could have predicted in the early 1990s when the Internet was introduced. As blockchain holds the potential for equal or even greater disruptions, particularly when combined with AI (see Section 3), revolutionary changes of considerable magnitude covering a wide range of industries and products/services will emerge over the next 20 years and new firms, corresponding to the eight ones mentioned will probably emerge. The great challenge for entrepreneurs is to direct their startups to exploit the emerging blockchain technologies and develop new applications and innovative products/services at affordable prices to better satisfy existing and emerging needs.

Below is a presentation of what we believe are the 10 most important ***existing*, *or soon to be introduced*** blockchain applications, highlighting their usage and advantages and mentioning the startups that have been formed to develop and implement them. These applications have been classified in terms of the industries that are being affected and the various applications being pursued. There is no doubt that many more applications will be introduced in the future, some of them becoming successful breakthroughs, in particular when combined with AI algorithms.

4. Industries

4.1. Banking

Blockchain banking applications can reduce costs by as much as $20 billion by eliminating intermediaries and increasing the safety and efficiency of banking transactions [5]. A leading startup in the field is ThoughtMachine that has developed Vault OS, which is run in the cloud, providing a secure, fast and reliable end to end banking system capable of managing users, accounts, savings, loans, mortgages and more sophisticated financial products (see https://www.thoughtmachine.net/). An alternative blockchain banking application is Corda, a distributed ledger platform that is the outcome of over 2 years of intense research and development by the R3 startup and 80 of the world's largest financial institutions. It meets the highest standards of the banking industry, yet it is applicable to any commercial scenario. Using Corda, participants can transact without the need for central authorities creating a world of frictionless commerce (see https://www.corda.net/). According to ***Business Insider*** [6], practically all major global banks are experimenting with blockchain technology trying to reduce cost and improve safety and operational efficiencies while, at the same time, making sure that they will not be left behind startups utilizing blockchain technologies to dominate the market.

4.2. Payments and money transfers

By avoiding a central authority to verify payments and money transfers, costs can be substantially reduced. At present, there are a good number of services using the technology aimed primarily at those without bank accounts or those looking for important cost savings. Below is a brief description of six blockchain services located in various parts of the world

- **Abra** (USA) is a mobile application allowing person-to-person money transfers. The app can be downloaded from Apple or Google stores.
- **Align Commerce** (USA) is a payment service provider (PSP) allowing businesses to send and receive payments in local currencies.
- **Bitspark** (Hong Kong) is an end to end remittance platform to any of their 100,000 plus locations worldwide.
- **Rebit** (Philippines) is a money transfer service offering significantly lower rates to the many Philippine immigrants working abroad.
- **CoinRip** (Singapore) is a service offering safe and quick money transfer charging a flat rate of 2%.
- **BitPesa** (Africa) is a cheap and safe money transferring service operating in Africa.

4.3. Securities trading

Blockchain technologies aim to reduce costs and speed up trading while also simplifying the settlement process. For these reasons, many stock exchanges are considering introducing blockchain to their operation. The London Stock Exchange, the Australian Securities Exchange and the Tokyo Stock Exchange are already experimenting with blockchain technologies which are expected to be operational in the near future. Banks and financial companies are also exploring blockchain applications for security trading. T-zero (see https://tzero.com/), a US startup, claims on its website to be the first blockchain-based trading platform that integrate cryptographically secure distributed ledgers with existing market processes to reduce settlement time and costs, increase transparency, efficiency and auditability.

4.4. Health care

Health care costs are skyrocketing, estimated to be around 10% of GDP in developed countries and exceeding 17% (close to $3 trillion) in the USA. This means that any effort to improve health care services can result in substantial savings and blockchain technologies are prime candidates to achieve such savings while improving efficiency and probably saving lives at the same time. There are short-term blockchain applications ready to apply and ambitious, long-term ones aimed at revolutionizing the health industry.

- *Security and trust:* collect complete health data (medical reports for each patient, history of illnesses, lab results and X-rays) in a secure manner, using a unique identifier for every person and only allow the sharing of such data with the express permission of the individual involved. Blockchain technology will eliminate the more than 450 health data breaches, affecting over 27 million patients, reported in 2016.

- *Exchangeability of information:* health information between the various actors is not communicated freely creating silos that hinder its effective utilization to improve health care. Blockchain technology can improve both the exchangeability of information and its quality leading to significant benefits.
- *Claim settlement and bill management:* facilitate claim settlement by reducing bureaucracy and introduce bill management to reduce fraud and speed up payment. This can be achieved more efficiently by creating consortia of health providers and insurers.
- *Authentication of medical drugs:* ensure the integrity of medical drugs based on current industry estimates pharmaceutical companies incur an estimated annual loss of $200 billion due to counterfeit drugs globally while about 30% of drugs sold in developing countries are considered imitations.
- *Clinical trials and medical research:* it is estimated that as much as 50% of clinical trials go unreported, and that investigators often fail to share their study results. Blockchain technologies can address the issues through the time-stamped, immutable records of clinical trials. Most importantly, the technology could facilitate collaboration between participants and researchers and could contribute in improving the quality of medical research.

Estonia has implemented a blockchain application, eHealth, covering all its citizens. In addition, there are a number of startups like GEM claiming to have developed the first application for health claims based on blockchain technology. This is done by introducing real time transparency and substantially reducing the time for bills to be paid by the sharing of the same platform among those involved. There are several other startups, some of which are already operating, and some on the way to becoming functional, like Guardtime, operating in Estonia and being used by patients, providers, private and public health companies and the government to store and access information from their eHealth system in a safe and efficient way. Similar functions are provided by Brontech, an Australian startup, offering reliable health data to improve the diagnostic process among others; Health Co aims at revolutionizing the relationship between medical researchers and users; Factom, Stratumn and Tierion are mostly concerned with improving the quality of health data while the purpose of Blockpharma is to fight drug counterfeiting.

4.5. Retail

The multinational eBay is the leader for online commerce between consumer-to-consumer sales. OpenBazaar, is a new startup challenging eBay by utilizing blockchain technology to decentralize online person-to-person trade. By running a program on their computer, users can connect to other users in the OpenBazaar network and trade directly with them. This network is not controlled or run by an owning organization but is decentralized and free. This means there are no mandatory fees to pay, and that trades are not monitored by a central organization (see https://www.cbinsights.com/company/openbazaar).

5. Applications

5.1. Smart contracts

Smart contracts are probably the blockchain technology with the highest potential to affect, or even revolutionize all sorts of transactions from the execution of wills to the Internet of Things (IoT). The major innovation of smart contracts is the elimination of trusted intermediaries. Consider, for example, the executor of a will who approves the directives of the deceased of how the money will be spent/allocated. Instead of an executor, a programmable, legally binding smart contract can achieve the same purpose, using blockchain technology, avoiding the trusted intermediary, while reducing costs and improving efficiency. An additional, application of smart contracts is with IoT, facilitating the sharing of services and resources leading to the creation of a marketplace of services between devices that would allow to automate in a cryptographically verifiable manner several existing, time-consuming work flows [7]. Most importantly, such technology is the central principle behind **Ethereum** (see below), a new extension of blockchain technologies focusing on running the programming code of decentralized smart contract applications.

5.2. Supply chain

Supply chain operations are dominated by paper-based methods requiring letters of credit (costing 1–3%) and factoring (costing 5–10%), increasing costs by an estimated trillion dollars and also slowing down transactions. Such costs could be reduced substantially, using blockchain technology that will eliminate intermediaries by establishing trust between buyers and sellers. There are several startups, among them, Skuchain, aiming its blockchain technology at the intersection of payments (letter of credit or wire transfer), finance (operating and short-term trade loans) and Provenance focusing on tracking the authenticity and social and environmental credentials of goods from the source all the way to the final consumer. In addition to startups, big companies like Walmart, are also aiming at exploiting the advantages of blockchain technology to improve efficiency and reduce supply chain costs [8].

5.3. IoT

Blockchain could revolutionize the IoT if applied securely to the estimated 8.5–20 billion of connected IoT devices that existed in 2017 and are expected to grow to 1 trillion by 2020. Exploiting the information generated by IoT devices intelligently can transform our homes and cities and have a profound effect on the quality of our lives while saving energy. According to Compton [9], *"Because blockchain is built for decentralized control, a security scheme based on it should be more scalable than a traditional one. And blockchain's strong protections against data tampering would help prevent a rogue device from disrupting a home, factory or transportation system by relaying misleading information"*. Eciotify, a startup, specializing in applying blockchain to the IoT, plans to roll out applications utilizing blockchain technology for IoT devices.

5.4. Decentralized cloud storage

Computer storage was decentralized in individual computers until about a decade ago when Dropbox was founded providing the first, modern, centralized cloud storage unit. Since then cloud computing was introduced revolutionizing applications by encouraging firms to outsource their storage needs to the likes of Amazon, Google or Microsoft Web Services. The advantage of such services was lower costs and greater reliability. Blockchain technology aims to re-decentralize computer storage to individual computers all over the world. According to experts [10], there are three major reasons for such a switch. First, the cost of most cloud services is around $25 per terabyte per month while the corresponding one of blockchain storage is 12.5 times cheaper at $2 per terabyte/month. Second, there is greater security as blockchain data is encrypted, meaning that only users holding the appropriate keys can view it (data stored in commercial cloud services could be viewed by third parties). Finally, blockchain cloud storage is immutable while providing a record of all historical changes done on the data.

5.5. Certification

One of the great promises of blockchain technology is that it can serve as a decentralized, permanently unalterable storage alternative for all types of information, or assets, not just as a currency or payment system. This makes the technology a prime tool for certifying all sorts of information, transactions, documents and records. What has attracted the greatest interest, however, is the certification of data (with the startup Stampery being the leader) and of identities (with the startup ShoCard being the leader). There are many, additional areas where certification using blockchain technology can be applied including the issuing of IDs and even voting.

6. Other blockchain applications

There are many additional applications exploiting blockchain technologies. These include true decentralized ride-sharing services (Uber and Lyft are actually centralized taxi services) like those offered by La'Zooz and Arcade City. Stratumn, a platform aiming to automate auditing, Synereo whose purpose is to aid users to create content, publish and distribute it online, Docusign offering the eSigniture solution and Steem, a social media platform where anyone can earn rewards, with some of these startups already operational while others are still being developed.

7. Specialized blockchain VC firms and geographical distribution of funding

According to FinTech News, in Switzerland eight major Venture Capital Firms have invested more than $1.55 billion in bitcoin and blockchain startups since 2012. Country wise the USA dominates the race with 55% of the total, followed by UK with 6%, Singapore with 3% and Japan, South Korea and China with 2% each. As interest in blockchain technologies increases, it is expected that VC investments will increase too accelerating the number of available applications.

8. Ethereum

Ethereum, like bitcoin, is a distributed public blockchain network (developed by the non-profit Swiss foundation of the same name) upholding its unique capabilities (Trust, immutability/transparency, disintermediation, low costs) but with the additional three:

- Running applications exactly as programmed without any possibility of downtime, censorship, fraud or third-party interference.
- Enabling developers to build and deploy decentralized applications, serving specific purposes that become part of the blockchain network and as such not controlled by any individual or central entity which is the case of Internet applications.
- Exploiting the ethereum virtual machine (EVM) to run any desired program, written in any programming language, by using the EVM developers, without the need to create blockchain applications from scratch but can utilize the thousands of existing ones already available (one type of such applications can be smart contracts).

8.1. Blockchain technologies: future prospects and major challenges

Blockchain is becoming one of the most remarkable technologies since the appearance of the Internet [11]. The large number of innovative applications based on this technology and the great interest shown from business firms, government organizations and individuals is mainly due to its ability to assure trust between parties that do not know each other, guarantee the safety of transactions and attest to the trustworthiness of the information, in addition to its other advantages. The interest in the technology can be seen from the Consensus Blockchain Conference, held in May 2017, which attracted more than 2000 participants and was just one of the more than 200 conferences held during 2017, as well as the more than 110 startups established in recent years and the exponentially increasing number of students attending blockchain programs. For instance, in the University of Nicosia's online blockchain course, there were 164 registrations from all over the world in 2017, versus 23 when this program was offered for the first time in 2013. In addition, there are 5495 registrations, from all five continents, who follow its MOOC class this year, versus 642 when it was first offered in the Spring of 2014. These numbers show the growing interest from the part of students while the university's blockchain placement office receives numerous requests each week from companies asking for graduates from its blockchain programs that could work for them.

The previous section of this chapter covered the blockchain technology and the various applications already, or in the process of, being implemented. This section discusses its future prospects and the challenges until its widespread adoption by business firms, governmental organizations and individuals. Faster and cheaper computers, lower storage costs and a host of specialized applications (some of them already discussed in the previous section) will accelerate its widespread adoption and will produce disruptive changes that will become revolutionary when blockchain is combined with AI algorithms, exploiting the advantages of both technologies. There are always the doubters saying that blockchain is overhyped [12, 13] but the same was true when the Internet was in its infancy back in 1995. In a ***Newsweek*** article in February of that year, Clifford Stoll, a computer expert, wrote *"Baloney. Do our computer pundits lack all common sense? The truth is no online database will replace your daily newspaper, no CD-ROM can take the place of a competent teacher and no computer network will change the way government works"* [14].

9. Future prospects

Recently, Christine Lagarde, IMF's Managing Director, gave a talk at the Bank of England entitled "Central Banking and FinTech, A Brave New World?" [15] providing her views of banking and policy making in the year 2040. Her talk concentrated on three themes (virtual/digital currencies, new models of financial intermediation and AI, all three major concerns of this paper too) and how they will affect the future as well as what should be done to deal effectively with the challenges they will pose. Her advice *was "we–as individuals and communities–have the capacity to shape a technological and economic future that works for all"*, adding that we have a responsibility to make it work, assuring that humans will be needed for all important decisions, even though machines will certainly play a greater role as time passes.

9.1. Governments adopt blockchain for their entire operations

Some countries are experimenting with blockchain while a few are ahead in adopting the technology in some functions of their operations. Estonia is a pioneer having already applied blockchain-based services in eHealth, eSecurity and eSafety, eGovernment Services and eGovernance (including iVoting), estimating that such services save 100 years of working time for its 1.3 million citizens. Countries like Sweden follow Estonia's example while Dubai plans to implement blockchain to its entire government by 2020, reducing CO2 emission by 114 million tons a year from fewer trips and saving 25.1 million hours and $1.5 billion annually from productivity increases in document processing alone [16]. According to an IBM sponsored survey [16], 9 in 10 government executives plan to make blockchain investments in financial transactions, asset and contract management and regulatory compliance by 2018. **Figure 1** shows the expectation of these executives to implement blockchain. According to the ***Economist***'s article [17], governments may become big backers of blockchain technology as they come to understand its benefits that according to Brian Forde, of the Massachusetts

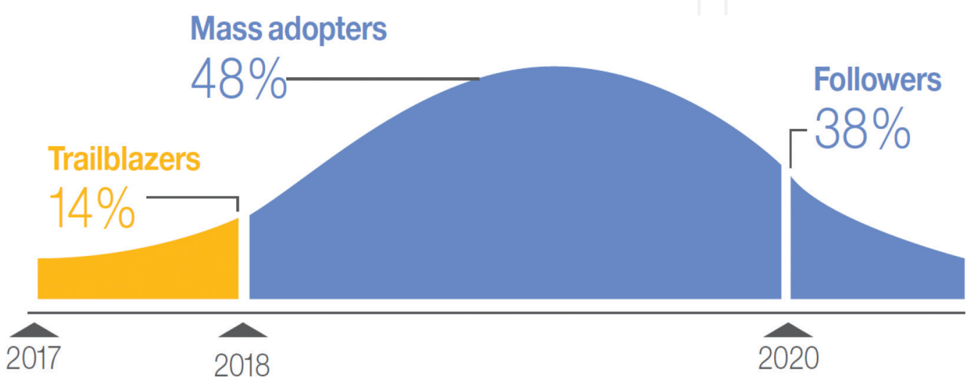

Figure 1. First to finish: Respondents' expectations of when they will have blockchains in productions and at scale.

Institute of Technology, is the driving force behind its widespread adoption. According to **Figure 1** and Forde, the future will probably witness a considerable number of blockchain applications in all areas of governmental operations.

Certificates and IDs are issued exclusively on blockchain: toward the end of 2017, the Dubai Land Department became the world's first government entity to conduct all its transactions through Blockchain technology [18]. Along the same direction, the Swedish National Land Survey and FinTech startup ChromaWay will test launch an initiative to put all land title records on Blockchain, and thereby safeguard the rights and interests of genuine property owners, eliminating or seriously reducing the chance of fraud [19]. Land records is just the tip of the iceberg, with all government (IDs, Passports, Driver Licenses, Birth Certificates, etc.) and educational certificates (Graduation Diplomas, Records of Programs/Courses taken, etc.) of potential candidates to be issued using blockchain technology. It is highly likely, therefore, to see a surge for this to happen with considerable cost savings, reduced bureaucracy and improved level of services.

9.2. Virtual (digital or crypto) currencies are adopted

While governments are buoyant about adopting blockchain for their operations, they are not so sure about virtual currencies, such as bitcoins, afraid of being used for tax evasion and possible criminal activities associated with the dark web. At present, the legal status of virtual currencies varies considerably from one country to another, with no indications of what countries plan to do in the future. China's recent decision to ban Initial Coin Offerings (ICO), calling them 'illegal fundraising' [20] as well as that of Russia to block cryptocurrency exchanges, are an indication of how virtual currencies are being treated by governments. At the same time, some countries (Switzerland, Singapore, South Korea, Japan, Dubai and Bahrain) are more open to adopt virtual currencies alongside their legal money, while others are openly hostile to its adoption. At the same time, international bodies like IFM encourage such an adoption, initially at least from countries with weak institutions and unstable national currencies. As time passes and the problems of volatility and hacking are addressed, virtual currencies are likely to play a complemental role, supplementing national ones, in trade and financial transactions, among others. However, at present, their future prospect is uncertain.

10. eHealth records

For health records to be useful they must be shared among doctors, laboratories, hospitals, pharmacies, government health agencies, insurance companies and researchers while, at the same time, protecting patients' privacy against unauthorized usage and breached health records. Although the challenge for doing so is tremendous, the Estonian eHealth Foundation is operating with considerable benefits, as a secure health record system that can become an example for other countries to follow, although it may be more difficult given the complexities of implementing the system in larger nations. In the USA, there are serious efforts to implement a blockchain health system that among other achievements can reduce fraudulent claims that are estimated at around 5–10% of health care costs at present. The challenge is how to digitize and standardize all health records, some of which are hand written. One system being developed to do so is MedRec [21] that according to its developers *"doesn't store* *health records or require a change in practice. It stores a signature of the record on a blockchain and notifies the patient, who is ultimately in control of where that record can travel. The signature assures that an unaltered copy of the record is obtained. It also shifts the locus of control from the institution to the patient, and in return both burdens and enables the patient to take charge of management"* [22]. According to Das [23], blockchain will probably play a significant role in the healthcare industry as it has started "*to inspire both relatively easily achievable and more speculative potential applications*". Healthcare authorities, governments and providers are excited about the available possibilities and are investing to achieve them, although these achievements maybe more evolutionary than abrupt.

10.1. Business firms adopting blockchain for their internal operations and external transactions

Blockchain, as discussed, is a distributed ledger of trustworthy digital records whose safety is assured and its history can be traced as new data is added and chained, at the end of old ones while no information can be erased. Businesses that can leverage these unique advantages can harness significant gains in efficiency, including lower costs, more effective auditing (the data is immutable) and eliminating, or making fraud practically impossible.

10.2. The banking and financial sector and FinTech firms

Blockchain technology can be used for secure and direct alternatives to the complex and expensive banking processes used today, reducing transaction costs from $25 to less than a single dollar and avoiding costly intermediaries [3]. Such a huge saving has obliged practically all major banks to test the technology and many of them have joined R3, a startup developing Corda, a blockchain-based platform geared toward the banking industry. Corda and similar platforms will transform the sector by simplifying operations, eliminating intermediaries, reducing operating costs and offering a wide variety of new, innovative products and services, in addition to opening up banking to billions of people who are excluded at present. Financial firms face similar challenges as banks. In remarks at a FinTech-focused conference at the end of September 2017, Yasuhiro Sato, the president and CEO of the Mizuho Financial Group, said "*the technology could 'change the strategies of international financial institutions,'* adding *'we should have the courage' to make the shift to blockchain **now***". The Japanese Bankers Association (JBA) announced earlier in September 2017 that it will partner with IT provider Fujitsu to test the viability of using a blockchain across financial services. Blockchain will transform the banking/financial sectors, as FinTech startups are disrupting incumbents by developing innovative blockchain platforms and offering new products/services at lower prices.

11. Supply chain operations

As mentioned, supply chain transactions are dominated by paper-based, time-consuming and bureaucratic procedures, involving banks, financial firms and custom agencies among others. In the future blockchain can eliminate the paper trail and introduce trust among the various players while also assuring firms receiving materials/parts and consumers on the authenticity of goods (from the raw materials to the final product). This can be done, for instance, by installing RFID tugs that can immutably record every movement of material/product, guaranteeing its provenance and testifying its physical presence, thus, eliminating the need for letter of credits, factoring and detailed inspections. Moreover, the optimization of supply chain can be achieved at present using AI for its logistics part (scheduling and planning) while it can be extended in the future to automate the majority of supply chain transactions (in conjunction with smart contracts) that could include the majority of AI transactions.

11.1. VA (autonomous vehicles) and IoT (Internet of Things)

The safety provided by blockchain technology is indispensable for the smooth running of self-driving vehicles and the untroubled functioning of IoT devices. By 2020, it is estimated that a sizable number of AVs will be on the road while there will be more than 1 trillion IoT gadgets, providing a unique challenge for blockchain technology to provide interconnectivity for all AVs and the smooth integration of the trillion of IoT devices. The implications are immense. If AVs are interconnected, they could communicate traffic jams, facilitate car sharing, receive and make payments and select the best insurance option among other tasks that can be performed using blockchain. Interconnected IoTs can optimize the functioning of all its devices, say at home, setting optimal temperatures, reducing energy consumption, ordering food and checking and paying utility bills.

12. Smart blockchain contracts instead of lawyers

Despite being in their infancy, smart contracts hold the potential to become a groundbreaking legal innovation, becoming a cornerstone of future commerce. At present, there are several problems limiting its applicability as a legal document [24]. Once these problems can be resolved, they can safely move assets around, interact with IoT devices and automate many business-related processes that demand human resources. How smart contracts will affect lawyers and law practices is debatable, with some predicting a serious decline in the need for lawyers [25] or at least providing an alternative to expensive legal practices.

13. Decentralized autonomous organizations (DAOs)

DAO is another major innovation of blockchain technology. A DAO is a company without a CEO, managers, employees or office buildings. It is created and run based on the computer code included in a smart contract. Although, the first DAO firm was hacked and its assets were stolen [26], the potential for DAOs are significant once the technical security problems are resolved. For instance, there is no reason for portfolio funds solely investing in market indexes to pay expensive executives, employ personnel and occupy offices when they can be run more effectively as a DAO, open 24/7. There are immense possibilities to be exploited, leading to great cost reductions and more efficient operations as DAOs, once perfected, are not prone to human errors.

14. Other applications

There are numerous, additional applications of the blockchain technology pointing to substantial improvements. Some of them are listed below while there is practically no limit to future ones being developed and implemented

- Blockchain-enabled energy trading saving millions of dollars per year.
- Maritime insurance, reducing costs, decreasing fraud and speeding up the settlement of claims [27].
- Identifying epidemics faster while avoiding to cause panic [28].
- Educational material can be exchanged safely among academic institutions while safeguarding the intellectual rights of the writers [29].

As the adoption of new technologies has accelerated over time [30], the same phenomenon would probably occur with blockchain, resulting in more applications and faster penetration rates allowing us to exploit its considerable benefits in record time and witnessing quickening progress in the field.

15. Challenges

The blockchain challenges can be classified as ***general***, referring to the technology itself and ***specific*** ones concerning virtual currencies.

General: adapting the blockchain technology and integrating it with existing IT systems may require significant changes, or even complete replacement of such systems, considerable initial investments and difficulties in hiring personnel to implement the technology. Although these problems are important, ready-made solutions and open systems may alleviate them, which are no different to when the Internet or other new technologies were first introduced. Another concern is the high electricity consumption required to run all of the computers in the network that some estimate to be equal to that of Ireland [31]. To avoid this problem alternative technologies to pure blockchain have been developed and utilized. DeepMind, for instance, uses a method called Merkle trees to track data changes without requiring verification from all networked machines. Such trees allow the efficient and secure verification of the contents of large data structures when the major objective is the safety and immutability of the data rather than ensuring trust between the parties involved. Similarly, the "algorand" algorithm [32] substantially reduces the amount of computations required and possesses additional desirable properties. In the future, transaction speeds, verification times and data limits will further improve through innovations in order to deal with the exponentially growing number of transactions.

Specific: virtual currencies are currently too volatile and therefore too risky to be acquired by the public while the fear of hacking and fraud is present. In addition, dealing with technical problems such as programming bugs in the code of smart contracts must be dealt with, as their consequences when the contracts are executed are critical. Finally, the problem of scalability of the blockchain technology must be addressed as some platforms are reaching their capacity and storage limits. The hope is that as prices rise so will the need for innovative solutions that will eventually solve practically all problems.

15.1. Combining blockchain and AI

As we have shown in this chapter, blockchain is a groundbreaking technology permitting the safe and reliable storage and transmission of data, among its other advantages. AI, on the other hand, is a revolutionary technology that can learn on its own by analyzing and discovering patterns in massive amounts of (big) data. There is, therefore, a natural complementarity between the two, as blockchain safely stores/transmits trustworthy data while AI requires huge amounts of reliable data to discover patterns and learn. In this section, we discuss the complementarity between the two technologies and consider the breakthrough innovations that could result by marrying them. The potential benefits are expected to be in the areas of medicine, autonomous vehicles (AV), smart contracts, Internet of Things (IoT), decentralized autonomous organizations (DAOs) and many additional areas of applications, not yet conceived at present. In many cases, AI could not be used without the assurance of the safety and reliability of the data provided by blockchain and vice versa the value of many blockchain applications will be limited without AI.

Two examples can illustrate the complementarity and mutual benefits of joining blockchain and AI. Consider AVs in the simple case, as more carmakers adopt "over the air (OTA)" software updates for their increasingly connected and autonomous cars the risk of a hacker hijacking and stealing the car will also increase. In a worse-case scenario, a car can be forced to cause accidents or create traffic jams while the worst possibility would be to hijack and program the car to accomplish simultaneous terrorist attacks in many cities. Similarly, if IoT devices can be hacked, a home's security will be compromised, or its equipment can malfunction. Therefore, the safety provided by blockchain is indispensable for the smooth utilization of AVs and IoTs. On the other hand, consider a smart contract application that depends on some environmental assumptions for its correct execution. Such a contract would be outdated once some of these assumptions do not hold, making AI monitoring imperative in order to allow learning and determining on its own when the environment has changed. Although at present the blockchain and AI technologies may not be at the point of being successfully combined, the prospects for doing so in the near future are encouraging, motivated by the substantial expected benefits. The remainder of this section describes such advantages, clearly recognized in China where the first alliance for integrating artificial intelligence and blockchain is being established to harness these benefits [33].

16. Government operations

Governments, apart from some pioneering ones already mentioned, are slow in adopting new technologies and blockchain and AI are no exceptions, particularly when AI as a technology is still in a developmental stage, apart from some applications in games and those involving language and image recognition [34]. This does not mean that there will not be significant progress in the future, as the steepest progress in AI only occurred a few years ago. At present, however, the majority of AI applications are centered on digital assistants, answering questions in natural language and in image, including face recognition techniques [35]. The future prospects however are huge, with estimated benefits running into the billions. AI applications could range from fighting tax evasion to establishing monetary and fiscal policies. The catchword of "cognitive AI", if it becomes a reality, can have profound implications in not only saving billions but also providing higher quality services to the public and increasing the level of democratization. Some governments such as those of Dubai are planning to introduce Blockchain into their entire operations reducing bureaucracy, improving their efficiency, reducing waste and pollution and saving billions in the process.

17. Digital currencies

It is not obvious how AI can be combined with the blockchain technology used in bitcoins and other cryptocurrencies, although this could be achieved in the future when DAOs and robots will be introduced, owning property and holding assets. In such a case, they will have to use AI to make the necessary M2M transactions or using bitcoins for making and receiving payments.

17.1. eHealth

While blockchain can assure safety and reliability, adding AI capabilities can greatly benefit the health sector. At present AI is mainly used for detecting abnormalities in X-rays and CT scans, a task performed at least as accurately as humans can, and for assuring a greater level of personalized medicine. According to experts, the future holds significant inventions given the momentous benefits that can be achieved by reducing medical costs and improving the quality of medical care. For this reason, all big players (Google, Microsoft, Apple and Amazon), as well as a host of startups are actively exploring AI for medical applications, aimed at improving the more effective utilization of patients' data, the accuracy of diagnosis, providing better recommendations, based on evidence-based research findings, and several other possibilities. These applications are on top of improvements in robotic surgery and digital advice provided though smartphone applications. According to Accenture [36], key clinical health AI applications can potentially create $150 billion in annual savings for the United States healthcare economy by 2026.

18. The banking and financial sector

The benefits of AI for the back office of banks and financial firms are widespread, as large histories of data are available. For a long time before AI was introduced, risk and fraud detection was predictive with great success using statistical decision rules. AI has improved such rules to a new level by allowing learning through the analysis of a huge amount (big) of data to identify patterns and improve decision-making. Klarna, a Swedish e-commerce company, provides instant evaluation of customers' credit worthiness for buying goods without a credit card. The same task is done by the Chinese Yongqianbao and several other firms. In addition, *"AI technology is being used to find the speediest way to execute trades, to make bets on market momentum, and to scan press releases and financial reports for keywords that could signal that a stock will rise or fall"* [37]. However, this is not the same with more accurate forecasting. Unfortunately, stocks and commodities behave like random walks and cannot be predicted any better than using the most recent price for future ones, according to efficient market theory [38]. For instance, in a recent study conducted by one of the authors of this paper [39], comparing statistical and AI (ML or NN) forecasting methods, it was found that the former were more accurate than the AI ones, half of which were less accurate than a random walk benchmark.

Clearly, present AI applications in banking and finance are just the tip of the iceberg and soon the power of AI to deliver better experiences, lower costs, reduce risks and increase revenues will become a reality and they may even progress to more accurate forecasting.

A prime example of successful AI applications is Numerai [40], a San Francisco hedge fund that makes trades using machine-learning models built by thousands of anonymous data scientists paid in bitcoin. Another is Polychain, a fund that buys bitcoin and other digital currencies and invests in a radically new breed of businesses owned, funded, and operated entirely by decentralized networks of anonymous online investors.

19. Supply chain operations

Blockchain technology is already utilized in supply chains while its integrations with AI is still in its infancy apart from its logistic part (what used to be the old scheduling/planning tasks) which is used extensively by some firms [41]. The challenge is in the future to extend AI to the remaining parts of the supply chain. Amazon, a pioneer in AI, has moved beyond just responding to customer demands by developing a whole profile for each customer and using such data in its AI applications. Manish Chandra and Anand Darvbhe of Accenture [42] point out, *"The use of AI in supply chains will ultimately result in spawning an ecosystem where supply chains link themselves with each other, enabling seamless flow of products and information from one end to the other"*, completely automating the process and achieving significant benefits in the process.

20. AV and IoT

Employing AI to AVs can go beyond just following a set course for taking its passengers from point A to B by continuously analyzing traffic information from connected AVs and learning to determine the route depending on the time, the day, the weather conditions and a host of other factors. Moreover, it can even modify the course of a journey, if necessary, when the AI determines that traffic patterns are changing. Similarly, IoTs devices can go beyond setting temperatures and ordering food by using AI to predict what the owners want and modify the settings to satisfy their evolving desires.

20.1. Cognitive blockchain smart contracts (IBM) and DAO

IBM is experimenting with turning smart contracts into "cognitive contracts" that can learn and adapt using AI [43]. This can be done by identifying pattern changes in the data, recognizing interesting interactions, detecting suspect activities, etc., in order to make recommendations for updating the smart contracts and taking specific actions based on insights gained from AI. Clearly, such cognitive contracts can be applied to DAOs to improve their effectiveness and value.

20.2. Matrix chain: merging blockchain and AI

Lately, efforts are being made to integrate AI and blockchain technologies into a single application. At the technical level this has been attempted by a new type of blockchain called the "MATRIX Chain" [44] whose aim is to merge blockchain and AI and set the path toward blockchain 3.0. The benefits that such technology will bring to distributed ledger technology comes down to making blockchain smarter and adding its ability to evolve through self-learning without the need to introduce AI as a separate technology.

A summary of the major applications integrating blockchain and AI is presented in **Table 1**, also showing an estimate of the extent of usage of each of the two technologies and the direction of what would need to be done to improve their future integration.

Major applications	Application uses mostly	Future requirements	
		More AI	More BC
Government operations	Neither BC/AI*	Yes	Yes
Digital currencies	BC	Yes	
eHealth	BC	Yes	Yes
Banking	BC	Yes	
FinTech	AI		Yes
Supply chain	Little BC	Yes	Yes
Autonomous vehicles (AV)	All AI		Yes
Internet of Things (IoT)	All BC	Yes	
Smart contracts	All BC	Yes	
DAOs	BC	Yes	

*Apart from exceptions as Estonia and a few other countries.

Table 1. Major applications, their current utilization of BC/AI and their future requirement.

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21. Conclusions

Blockchain technology, according to Muneeb Ali, Blockstack Co-Founder, ***"can help us advance from a 'don't be evil' world to a 'can't be evil' world"***. Blockchain transactions assure trust and reliability, improve security and remove intermediaries from value chains. In a chapter, Tasca and Ulieru [3] state that, in a not-so-distant future, our economic structure will be organized around person-to-person decentralized platforms that could enable real sharing of marketplaces without intermediaries and central hubs, where all transactions between consumers and service providers will be done through decentralized, person-to-person networks. They discuss Uber and Airbnb as examples. Both companies create extra value exploiting their monopolistic advantage, derived from their centralized, proprietary software platforms, which allow them to dictate their conditions to drivers/owners and customers. LaZooz, using blockchain technology, on the other hand, has developed a decentralized transportation platform owned by the community, utilizing vehicles' unused space to create a variety of smart transportation solutions. LaZooz works with a "Fair Share" rewarding mechanism sharing value creation among developers, users and backers. Similarly, Slock (an Italian startup), uses open source blockchain technology, to develop the Universal Sharing Network (USN) to eliminate Airbnb's monopolistic advantages.

In addition to startups, established companies also seek to exploit the advantages of blockchain technology and diminish the monopolistic advantages of Internet giants. The CEO of TUI, the largest tourist firm in the world, believes that blockchain technology will break the almost "monopolistic" hold that Priceline, Expedia, Booking.com and Airbnb have today in the lodging and distribution ecosystem [45]. He believes that these firms create superior margins because they take advantage of their monopolistic power and that blockchain will destroy that. TUI, he explained, has already moved all of its contracts into its private blockchain. "We are using it today predominantly to have mechanisms to swap bedstock between different PMSs [Property Management Systems]," he said. "The next step is that the whole inventory will be on the blockchain." Then using smart contracts, which are simply code snippets that execute automatically on the blockchain, Joussen argues it can easily manage and automate a large part of bedstock and hotel capacity between all the markets TUI operates.

Clearly, TUI is not the only company developing blockchain applications. So, the critical question is how all these applications will affect the competitive landscape and how innovative startups will utilize blockchain technologies to disrupt established players and create the corresponding success stories of Amazon, Google and Facebook, among others, in the emerging Internet of value. In answering this question, we should have in mind Amara's law that states, *"We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run"*. We strongly believe that in the long term, the Internet of Value will bring changes of equal or greater magnitude to those of the existing Internet of communications. The critical question is how to recognize such changes as soon as possible and how to profit by implementing them to gain competitive advantages. There is little doubt in our minds that in the next couple of decades, innovative, entrepreneurial startups marrying blockchain and AI technologies will disrupt established industry leaders such as Google, Amazon, Facebook, Uber and Airbnb, although they may not reach their size because of the limitations being imposed by the decentralized attributes of the blockchain technology.

For us, the most interesting question is "who and in what areas are going to emerge the new Googles, Baidus, Facebooks, Amazons and Alibabas and how will they successfully exploit blockchain and AI, although such a marriage may still be several years away?"

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References

[1] IBM. IBM Study: C-suite executives exploring Blockchain aim to disrupt, Not Defend; 2017

[2] McKendrick J. Blockchain as Blockbuster: Still Too Soon to Tell, But Get Ready. Forbes; 2017

[3] Prisco G. Move Over Uber: Blockchain Technology Can Enable Real, Sustainable Sharing Economy; 2016. Available: https://bitcoinmagazine.com/articles/move-over-uber-blockchain-technology-can-enable-real-sustainable-sharing-economy-1480629178/. Last accessed 30 October, 2017

[4] CBInsights.Com. Banking Is Only The Beginning: 36 Big Industries Blockchain Could Transform. 2018. Available: https://www.cbinsights.com/research/industries-disrupted-blockchain/?utm_source=CB+Insights+Newsletter&utm_campaign=fa48df10a8-ThursNL_02_01_2018&utm_medium=email&utm_term=0_9dc0513989-fa48df10a8-90141994

[5] Tasca P, Aste T, Pelizzon L, Perony N, editors. Banking. Beyond Banks and Money: Springer International Publishing; 2017

[6] Kocianski S. The blockchain in banking report: The future of blockchain solutions and technologies. 2017 Available: http://www.businessinsider.com/blockchain-in-banking-2017-3. Last Accessed 30 October, 2017

[7] Christidis K, Devetsikiotis M. Blockchains and smart contracts for the internet of things. In: IEEE Access. 2016. DOI: 0.1109/ACCESS.2016.2566339

[8] Lohade N. Dubai Aims to Be a City Built on Blockchain, WSJ. 2017

[9] Compton J. How Blockchain Could Revolutionize The Internet Of Things. 2017. Available: https://www.forbes.com/sites/delltechnologies/2017/06/27/how-blockchain-could-revolutionize-the-internet-of-things/#7617423b6eab. Last Accessed 30 October, 2017

[10] Maor R. Cloud Computing: The Future Belongs to Blockchain. . 2017 Available: http://www.forbes.co.il/news/new.aspx?Pn6VQ=L&0r9VQ=EIMKF. Last Accessed 30 October, 2017

[11] Marvin R. Blockchain: The Invisible Technology That's Changing the World. 2017. Available: https://www.pcmag.com/article/351486/blockchain-the-invisible-technology-thats-changing-the-wor. Last Accessed 30 October, 2017

[12] Bloomberg J. Eight Reasons To Be Skeptical About Blockchain. 2017. Available: https://www.forbes.com/sites/jasonbloomberg/2017/05/31/eight-reasons-to-be-skeptical-about-blockchain/1. Last Accessed 30 October, 2017

[13] Flieswasser K. Will blockchain disrupt or go bust?. 2017 Available: https://www.topbots.com/6-challenges-preventing-widespread-blockchain-technology-adoption/. Last Accessed 30 October, 2017

[14] Stoll C. Why the web won't be nirvana. 1995. Available: http://www.newsweek.com/clifford-stoll-why-web-wont-be-nirvana-185306. Last Accessed 30 October, 2017

[15] Lagarde C. Central Banking and Fintech—A Brave New World?. 2017 Available: https://www.imf.org/en/News/Articles/2017/09/28/sp092917-central-banking-and-fintech-a-brave-new-world. Last Accessed 30 October, 2017

[16] Smart Dubai. Dubai blockchain strategy. 2016. Available: http://www.smartdubai.ae/dubai_blockchain.php. Last Accessed 30 October, 2017

[17] Economist (The). Intelligence Unit Artificial Intelligence in the Real World: The business case takes shape, London. 2016

[18] Gulf News. Dubai has world's first government entity to conduct transactions through Blockchain network. 2017. Available: http://gulfnews.com/business/property/dubai-has-world-s-first-government-entity-to-conduct-transactions-through-blockchain-network-1.2101819. Last Accessed 30 October, 2017

[19] Rajashekara M. 3 Ways In Which Fintech Is Riding The Blockchain Wave. 2017. Available: http://www.huffingtonpost.in/rajashekara-v-maiya/3-ways-in-which-fintech-is-riding-the-blockchain-wave_a_21876915/. Last Accessed 30 October, 2017

[20] BBC. China bans initial coin offerings calling them 'illegal fundraising'. 2017 Available: http://www.bbc.com/news/business-41157249. Last Accessed 30 October, 2017

[21] Ekblaw A et al. A case study for Blockchain in healthcare: "MedRec" prototype for electronic health records and medical research data. IEEE Conference August. 2017;**2016**:22-24

[22] Halamka D, Lippman A, Ekblaw A. The Potential for Blockchain to Transform Electronic Health Records. 2017. Available: https://hbr.org/2017/03/the-potential-for-blockchain-to-transform-electronic-health-records. Last Accessed 30 October, 2017

[23] Das R. Does Blockchain Have A Place In Healthcare?. 2017 Available: https://www.forbes.com/sites/reenitadas/2017/05/08/does-blockchain-have-a-place-in-healthcare/. Last Accessed 30 October, 2017

[24] Agrello. How to Make Smart Contracts Worthy of Their Name Using Artificial Intelligence. 2017. Available: https://blog.agrello.org/how-to-make-smart-contracts-worthy-of-their-name-using-artificial-intelligence-3a90e4dd3c47. Last Accessed 30 October, 2017

[25] Artificiallawyer.com. OpenLaw Brings Legal Norms to Blockchain Token Transactions 2017. Available: https://blog.agrello.org/how-to-make-smart-contracts-worthy-of-their-name-using-artificial-intelligence-3a90e4dd3c47. Last Accessed 30 October, 2017

[26] Levine M. Blockchain Company's Smart Contracts Were Dumb. 2016. Available: https://www.bloomberg.com/view/articles/2016-06-17/blockchain-company-s-smart-contracts-were-dumb. Last Accessed 30 October, 2017

[27] EY.com. EY, Guardtime and industry participants launch the world's first marine insurance blockchain platform 2017. Available: http://www.ey.com/gl/en/newsroom/news-releases/news-ey-guardtime-and-industry-participants-launch-the-worlds-first-marine-insurance-blockchain-platform. Last Accessed 30 October, 2017

[28] Jones B. The CDC Wants to Use Blockchain as a Weapon Against Deadly Epidemics. 2017. Available: https://futurism.com/the-cdc-wants-to-use-blockchain-as-a-weapon-against-deadly-epidemics/. Last Accessed 30 October, 2017

[29] Acheson N. Blockchain and Education: A Big Idea in Need of Bigger Thinking. 2017. Available: https://www.coinndesk.com/blockchain-education-big-idea-need-bigger-thinking/. Last Accessed 30 October, 2017

[30] McGrath RM. The Pace of Technology Adoption Is Speeding up, Harvard Business Review. 2013

[31] O'Dwyer KJ, Malone D. Bitcoin Mining and Its Energy Footprint, ISSC 2014/CIICT 2014, Limerick. 2014

[32] Chen J, Micali S. Algorand. Technical report, 2017. URL http://arxiv.org/abs/1607.01341

[33] AIES. First Alliance for the Development of Artificial Intelligence and Block Chain Technologies will be Established in China for the Development of Integration of the two Technologies. 2017 Available: http://aies.in/first-alliance-development-artificial-intelligence-block-chain-technologies-will-established-china-development-integration-two-technologies/ Last Accessed 30 October, 2017

[34] Pontin J. Greedy, Brittle, Opaque, and Shallow: The Downsides to Deep Learning, Wired.Com. 2018 Available: https://www.wired.com/story/greedy-brittle-opaque-and-shallow-the-downsides-to-deep-learning/

[35] Deloitte. AI-augmented government: Using cognitive technologies to redesign public sector work, The Deloitte Center for Government Insights 2017

[36] Accenture. Why the artificial intelligence is the future of growth. 2017. Available: https://www.accenture.com/us-en/insight-artificial-intelligence-future-growth. Last Accessed 30 October, 2017

[37] Satariano A, Kumar N. The Massive Hedge Fund Betting on AI. 2017 Available: https://www.bloomberg.com/news/features/2017-09-27/the-massive-hedge-fund-betting-on-ai. Last Accessed 30 October, 2017

[38] Malkiel BG. A Random Walk Down Wall Street: The Time-Tested Strategy for Successful Investing. New York: W.W. Norton; 2017

[39] Makridakis S, Spiliotis E, Assimakopoulos V. The accuracy of machine learning (ML) forecasting methods versus statistical ones: Extending the results of the M3-competition. 2017. In: UNIC Working Paper. 2017

[40] Craib R. A New Cryptocurrency For Coordinating Artificial Intelligence on Numerai. 2017. Available: https://medium.com/numerai/a-new-cryptocurrency-for-coordinating-artificial-intelligence-on-numerai-9251a131419a. Last Accessed 30 October, 2017

[41] CB Insights. Amazon Strategy Teardown: Building New Business Pillars In AI, Next-Gen Logistics, And Enterprise Cloud Apps. 2017. Available: https://www.cbinsights.com/research/report/amazon-strategy-teardown/. Last Accessed 30 October, 2017

[42] Chandra M, Darbhe A. Artificial Intelligence: The next big thing in Supply Chain Management. 2016. Available: http://www.financialexpress.com/industry/artificial-intelligence-the-next-big-thing-in-supply-chain-management/329033/. Last Accessed 30 October, 2017

[43] IBM, Building Trust in Government: Exploring the Potential of Blockchain, IBM Institute of Business Value and the Economist Intelligence Unit, London. 2017 Available: https://www-03.ibm.com/press/us/en/pressrelease/52418.wss. Last Accessed 30 October, 2017

[44] Hebblethwaite C. Merging blockchain and AI with MATRIX Chain. 2017. Available: https://www.blockchaintechnology-news.com/2017/08/08/merging-blockchain-ai-matrix-chain/. Last Accessed 30 October, 2017

[45] Montali D. Blockchain Will Disrupt Expedia and Airbnb, TUI CEO Says. 2017. Available: https://skift.com/2017/07/11/blockchain-will-disrupt-expedia-and-airbnb-tui-ceo-says/. Last Accessed 30 October, 2017

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