

# Blockchain and AI

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Today, data remains digital silos and there is no real incentive to share it. This results in the hoarding of consumer data by companies like Google, Facebook, Alibaba and Baidu. Presently, artificial intelligence (AI) platforms give power to those few organizations that process a bulk of data. With exponential rise in consumer data generated by sensors and other devices, a race has begun to get this data and capture it in distributed databases instead of digital silos. Blockchain is potentially the technological solution to enable this.

A blockchain is a decentralized, public digital ledger that keeps track of cryptocurrency transactions in a chronological order. The most interesting part about blockchain is we can have factual data that can't be altered. Consider AI technology that gets into blockchains of data to get information, to discover patterns, and develop insights according to patterns. Most predictions and patterns are more accurate as compared to the knowledge mining that AI performs now, which uses incomplete, missing data most of the time. Between blockchain and AI, the data is extensible and the fallible human elements are virtually eliminated.

## What is it

What is blockchain?

A blockchain can be described as spreadsheet duplicated across a network of computers. It is a distributed and tamper-proof repository that provides a way for information to be recorded and shared through peer-to-peer community. The data that a blockchain contains is shared and no single authority has the official or unique source of data. An analogy would be a Google Sheet where the document is not stored on Google's servers but served by all the participants, with each new entry going through an agreement protocol (consensus mechanism) that establishes the reconciled state of the document that everybody believes to be the shared true state.

Why is blockchain needed?

Decentralized technologies have the potential to increase opportunities and effectiveness of data by providing an open platform that addresses interoperability challenges. But why should we leverage blockchain?

1. Intermediaries are inefficient or not trusted as arbiters of truth
2. Enhanced security ensures integrity of the system
3. Parties can trust that transactions are valid
4. Multiple parties can generate transactions that have broad benefits

What is AI?

AI (artificial intelligence) is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions) and self-correction.

How could AI and blockchain be two peas in the same pod?

Both blockchain and AI are individually technologies that have come of age. Blockchain is a distributed data management system that by itself does not have any intelligence. AI is technology that adds intelligence to data. With large volumes of data managed on distributed networks, the opportunity to make intelligent decisions on the data can

facilitate life-altering processes, making it possible perhaps for example for there to be solutions to address some very large global issues.

## Blockchain AI in Manufacturing and High-Tech Production

Blockchain is poised to fundamentally redesign inefficient processes in areas such as supply chain management and trade finance, as well as spawn entirely new business models for manufacturers. While manufacturers recognize the disruptive potential of blockchain to streamline complex supply chain operations, simplify trade finance and spur the transition to customized manufacturing made possible by 3D printing, most manufacturers are not moving aggressively to prepare for the transformative changes that blockchain will bring.

Coordinating among the thousands of organizations involved in a global supply chain and gaining the required assurances is a slow and often expensive process entailing paperwork, e-mails, phone calls and site visits. Despite these best efforts to gain assurances among suppliers, manufacturers and other users of raw materials confront billions of dollars a year in fraud and leakage.

As the value chains that support manufacturing in today's global environment depend on achieving trust among suppliers, distribution partners, service providers and customers, blockchain can positively impact operational efficiencies, reduce production costs and create new business opportunities. This network would provide manufacturers with a granular and real-time view of their global supply chain, documentation of the chain of custody for their products, and immutable records that cannot be altered inappropriately or tampered with.

### Developing a Blockchain Strategy

Manufacturers need to take blockchain from theory and put it into practice, identifying concrete business problems and opportunities that the technology can help address. For each use case, a manufacturer should:

- Determine key performance indicators that can be used to evaluate success. The KPIs will allow the organization to assess performance and communicate value to senior management.
- Ensure the blockchain project addresses specific business problems or opportunities. Rather than emanating from IT, the initiative should involve key stakeholders from the outset and should be driven by cross-functional teams with a business sponsor.
- Set clear goals. Assess whether blockchain technology is well suited to the business issue being addressed, and clearly specify which objectives will be achieved.
- Specify the actions needed for implementation. Assess the required resources, create a process map and develop an implementation guide.
- Explore a variety of platforms, including both permissioned and permissionless. For each use case, choose a platform based on how well it is tailored to the business need, and not the one with the most buzz.
- Gain experience collaborating with other players across the value chain. Work with industry partners on blockchain projects and assess the obstacles in working successfully with external organizations.
- Focus on blockchain projects with real-world potential. The risk of doing nothing is greater than the risk of doing the wrong thing.

### Looking Forward

Blockchain's distributed ledger technology could offer manufacturers the ability to streamline the current time-consuming and expensive processes involved in selecting, vetting and managing relationships with the numerous partners in their complex global supply chains.

While it appears manufacturers are moving cautiously, they do need to move off the sidelines by forming blockchain task forces, identifying use cases, designing pilot projects with specific implementation plans and acquiring the needed skills, either internally or through acquisitions and partnerships.

However, it's critical for manufacturers to take a nimble, entrepreneurial approach that is required to keep pace with any fast-changing technology, especially one like blockchain. Manufacturers that act aggressively to learn how to leverage blockchain will capture early-mover advantages as blockchain disrupts the manufacturing landscape.

## Blockchain AI in Supply Chain

Managing today's supply chains—all the links to creating and distributing goods—is extraordinarily complex. Depending on the product, the supply chain can span over hundreds of stages, multiple geographical locations, a multitude of invoices and payments, have several individuals and entities involved, and extend over months of time. Due to the complexity and lack of transparency of our current supply chains, there is interest in how blockchains might transform the supply chain and logistics industry.

How is the supply chain broken?

Supply chains used to be relatively simple because commerce was local, but they have grown incredibly complex. Throughout the history of supply chains there have been innovations such as the shift to haul freight via trucks rather than rail or the emergence of personal computers in the 1980s that led to dramatic shifts in supply chain management. Since manufacturing has been globalized, our supply chains are heavy with their own complexity.

It's incredibly difficult for customers or buyers to truly know the value of products because there is a significant lack of transparency in our current system. In a similar way, it's extremely difficult to investigate supply chains when there is suspicion of illegal or unethical practices. They can also be highly inefficient as vendors and suppliers try to connect the dots on who needs what, when and how.

How can blockchain help supply chains?

Blockchain has many applications and can be used for any exchange, agreements/contracts, tracking and payment. Since every transaction is recorded on a block and across multiple copies of the ledger that are distributed over many nodes (computers), it is highly transparent. It's also highly secure since every block links to the one before it and after it. There is not one central authority over the blockchain, and it's extremely efficient and scalable. Ultimately, blockchain can increase the efficiency and transparency of supply chains and positively impact everything from warehousing to delivery to payment. Chain of command is essential for many things, and blockchain has the chain of command built in.

How can blockchain AI help supply chain?

Data has always been a fundamental component of international trade and transportation, but never has so much information been available as today. Remote sensing, telematics, connected devices and vehicles all generate huge volumes of valuable data – the only challenge for organizations in the logistics and supply chain industry is how to harness this information and turn it into insight. Blockchain and AI can integrate data from any number of diverse sources, devices and systems, and enable enterprises to optimize every aspect of their supply chains.

Modern-day business relies on a complex web of supply chains, with products, parts and materials often shipped thousands of miles and from many destinations around the globe. AI is critical for optimizing these international routes, but also for improving the efficiency of transportation in the “last mile” of delivery – and even in the warehouse itself.

Using AI algorithms enables businesses to leverage historic trip sheets and real-time data to estimate time of delivery, and to optimize vehicle routes and sequence deliveries using information on local conditions such as traffic and weather. Data-driven dashboards also provide valuable insight into the performance of drivers, facilities and operations, enabling organizations to examine key performance indicators such as total travel time, helping to benchmark and improve service planning.

With retailers under pressure to optimize delivery times and competing with each other to provide next day or even same-day delivery, these principles are also being used to improve warehouse operations. AI-powered systems can instantly map capacity and availability of goods within the warehouse, and match available manpower most effectively with current levels of demand.

## Blockchain AI in Retail & Wholesale

While blockchain is not going to revolutionize retail tomorrow, there are enough changes coming and enough real players involved in innovation and investment, that retailers need to pay attention to how it will impact their industry.

### Consumer payments

High transaction costs constrain a market. That’s basic economics in the sense that a high price for a good or service depresses demand for the good or service. Compare mobile payments in China vs. the US: US credit card transaction costs over 200 basis points, vs. less than 50 for WeChat or AliPay in China. In 2016, the mobile payment market in China reached \$5 trillion, vs. \$112 billion in the US. One of the reasons why Bitcoin and other crypto-currencies are getting such buzz is because they offer an opportunity to bypass “expensive” forms of payment for something much cheaper.

So, there is the potential for a lot of demand for crypto-currencies from a consumer perspective, but right now it’s a pretty complex process to set up a digital wallet, gain access to a crypto-currency exchange, and start buying up coins. Is there a way to make that easier? One startup in Singapore, TenX, is connecting its digital currency wallet to a Visa wallet, making it possible for consumers to use a Visa card to spend crypto-currencies. Another company, BitPay, offers a Bitcoin payment integration to point of sale, so that retailers can accept the crypto-currency as a form of payment. Some retailers are even already accepting Bitcoin as a form of payment.

The biggest challenge is still that the value of crypto-currencies is very volatile. Some of that volatility is technology-driven. Security of some of the crypto-currency markets is also not assured. That’s the kind of news that still makes the average consumer uneasy when it comes to holding or using crypto-currencies.

### Product Pedigree

Blockchain, because it is a distributed ledger, makes counterfeiting very hard. That’s part of the value of the technology that makes it attractive as a currency. Blockchain makes it possible for every legitimate touch in a supply chain – from a supplier to a manufacturer to a shipper – to add a verifiable record to an item’s pedigree.

This has applications like making it harder to pass off that Hermes or Louis Vuitton bag as “genuine” when it’s not. It makes country of origin labeling and product safety tracking easier in things like the food supply chain, where blockchain makes it possible to record every touchpoint in the lifespan of a product as it moves through the supply chain, from farm to fork. It also has applications for assuring the authenticity of unique goods, like art or Super Bowl tickets. This can also be adapted to ensure confidence in resale markets.

#### B2B payments

One of the biggest challenges for crypto-currencies is acceptance as a real currency. To get there, banks would have to be willing to hold crypto-currencies as deposits, and participate in exchanging crypto-currencies for cold, hard cash. Right now, banks are experimenting with blockchain technology, not just to take deposits or trade currencies. At least twenty-eight banks from around the world are currently participating in a SWIFT-driven blockchain proof of concept to determine if they can use it to settle cross border transactions.

## Blockchain AI in Financial Services & Insurance

Billions of individuals and businesses are served and trillions of dollars are moved around the antiquated global financial system each day. Still heavily reliant on paper, albeit dressed up with a digital façade, there are many issues with this system that cause added expense and delays as well as make it easier for crime and fraud to cripple it. Despite the financial industry’s resistance to change, blockchain and its expected benefits make it worthwhile.

#### What blockchain can do for the financial and banking industry

##### Fraud Reduction

Even though blockchain is new technology, its potential to reduce fraud in the financial world is getting a lot of attention since 45% of financial intermediaries such as stock exchanges and money transfer services suffer from economic crime every year. Most banking systems around the world are built on a centralized database that is more vulnerable to cyberattack because it has one point of failure rather than many—once hackers breach the one system they have full access. The blockchain is essentially a distributed ledger where each block contains a timestamp and holds batches of individual transactions with a link to a previous block. This technology would eliminate some of the current crimes being perpetuated online today against our financial institutions.

##### Know Your Customer (KYC)

Financial institutions spend anywhere from \$60 million up to \$500 million per year to keep up with Know Your Customer (KYC) and customer due diligence regulations according to a Thomson Reuters Survey. These regulations are intended to help reduce money laundering and terrorism activities by having requirements for businesses to verify and identify their clients. Blockchain would allow the independent verification of one client by one organization to be accessed by other organizations so the KYC process wouldn’t have to start over again. The reduction in administrative costs for compliance departments would be significant.

##### Smart Contracts

Because blockchains can store any kind of digital information, including computer code that can be executed once two or more parties enter their keys, blockchains enable us to have smart contracts. This code could be programmed to create contracts or execute financial transactions once a certain set of criteria has been achieved—delivery of products could signal an invoice to be paid, for example.

## Payments

Blockchain disruption could be highly transformative in the payments process. It would enable higher security and lower costs for banks to process payment between organizations and their clients and even between banks themselves. In the current reality, there are a lot of intermediaries in the payment processing system, but blockchain would eliminate the need for a lot of them.

## Trading Platforms

There's no doubt that the risk of operational errors and fraud would be dramatically reduced with blockchain. NASDAQ and the Australian Securities Exchange are already exploring blockchain solutions to reduce costs and improve efficiencies.

## Hurdles to blockchain implementation for financial services

The blockchains that would be used by financial institutions would need to comply with privacy laws of today and the future and need to ensure the safety of the data. There are many questions regarding regulatory oversight for this new technology that need to be sorted out. And, any blockchain used in this sector would need to handle an extraordinarily large data set, therefore scalability is incredibly important.

## Blockchain AI in Utilities

### Potential Impact on the Utility Business Model

Utilities may be able to leverage this technology for supply chain, asset management and organizational performance applications. In the short term, there may be some areas that could be heavily impacted while others may be minimally impacted. In the long-term however, blockchain has disruptive potential across the utility value chain. It is important to point out that blockchain will not replace relational databases for business-critical processes in the medium term. Relational databases still have a decisive advantage when it comes to performance. Blockchain has the advantage when it comes to providing a robust, fault-tolerant way to store critical data and manage smart contracts.

### How the Core Technology is Evolving

Currently there are approximately 40 startups operating globally in the energy blockchain space. These startups are working with the underlying technology of bitcoin and particularly on permissioned (private) platforms. However, the technology still needs time to mature and the core developer network estimates that this may be 2-5 years away, as such, we are in the midst of an experiment and right now blockchain technology is too slow to handle real-time market needs. What is needed is a much higher output volume e.g. 1 million transactions per second, and that needs to be combined with privacy concerns. Unlike the financial services industry, the energy industry needs much faster confirmation times to make IoT applications a reality, and unlike the financial service industry, permissioned based blockchains will emerge due to national, regulatory and privacy concerns. Currently we are seeing the creation of consortia in the industry that are aiming to improve the underlying technology and trial specific use cases.

### The Rise of the "ICO" in Energy

At this stage six energy-focused blockchain firms across North America, Europe, Australia and Asia have token sales in the hundred of millions of dollars. There are at least 15 energy and utility related ICOs that have occurred or will occur in the near term in the industry. The vast majority of energy startups at this stage are focusing on very similar solutions – building decentralized energy marketplaces.

## The 4<sup>th</sup> Industrial Revolution (4IR) & the Role of Energy

Over the next decade advancements in Artificial Intelligence (AI), distributed ledgers and robotics will impact a variety of sectors. For utilities, these trends combined with the dramatic changes in the energy transition such as distributed energy resources, increased proliferation of sensors on infrastructure and behind the meter devices and demand management advances will unleash a variety of transformative use cases in the sector. For example, devices which auto-detect demand levels on the grid and reduce power could be powered by AI and recorded by blockchain. To that end, we are currently in the midst of what has been termed the Fourth Industrial Revolution (4IR), and a central part of this revolution will be energy and all of its components.

As with all complex deployments of new technologies, use cases with achievable value propositions should be first considered as well as those systems that satisfy the need currently. That said, the three largest segments of use case activity currently include:

- Renewable management, where use cases run the gamut of renewable forecasting, equipment maintenance, wind and solar efficiency and storage analysis. For example, in Germany a machine-learning program, named EWeLiNE, could work as an early-warning system for grid-operators to assist them in calculating renewable-energy output over the next 48 hours using AI and in Japan, GE is using AI to enhance wind turbine efficiency and is raising power output by around 5% and lowering maintenance costs by 20 percent.
- Demand management is also seeing an explosion of AI activity with use cases covering areas such as demand response, building energy management systems, overall energy efficiency and DR game theory. For example, using their AI focused company DeepMind, Google was able to reduce its total data center power consumption by 15 percent which will translate to hundreds of millions of dollars over the next several years. Google also suggest that they have already saved 40 percent alone on power consumed for cooling purposes by using AI.
- Infrastructure management and managing the performance of the grid is also getting AI attention. In this area use cases include digital asset management, equipment operation and maintenance and generation management. For example, in a test by Siemens who are deploying the technology in Asia, after AI took over control of a gas turbine combustion unit, nitrogen oxide levels dropped by 20 percent. We are also seeing Siemens leverage their industrial cloud platform, MindSphere, with IBM Watson to deliver predictive analytics, prescriptive analytics and cognitive analytics.

## Blockchain AI in Chemicals, Oil & Gas

Blockchain serves as a shared database that eliminates the role third parties play in transaction processes and information sharing in a number of ways. Technology, inventories, contracts, payments and other data is shared directly between parties with encrypted connections. Commodity exchanges on blockchain, for example, can support oil and gas trading directly between parties anywhere in the world, while removing the role banks, brokerage firms or other intermediaries have traditionally played.

### Smart Trades

One of the most obvious and powerful uses for the digital ledger technology is to provide a reliable and efficient platform for executing and recording energy trades. Ownership is tracked as assets change hands multiple times before settlement. Keeping land title records on a distributed ledger can provide much more efficient updates and data management for joint ownership and interest validations for energy trades.

The entire non-hydrocarbon supply chain could be transformed with blockchain. The interaction with thousands of suppliers, vendors and counterparties drives up complexity and cost but blockchain could help companies monitor compliance from their suppliers.

Additionally, the introduction of smart contracts, which are essentially computer code stored on blockchain that can execute actions under specified circumstances, should give oil and gas executives greater interest to improve their supply chain and finance activities.

Smart contracts enable counter-parties to automate transaction tasks that are typically performed manually and that require the involvement of third-party intermediaries. Smart contract technology can result in processes that are faster and more accurate and cost efficient. Also, the parties to a smart contract agree to be bound by the rules and determinations of the underlying code, which in theory should lead to fewer contract disputes.

#### Better Visibility

Blockchain can also help to streamline regulatory filings and reporting by improving transparency.

Regulators are increasingly requiring companies to provide vast amounts of data that can be analyzed to detect non-compliance and other regulatory issues. With current technologies and methods, gathering and cleaning up the required data is a huge burden.

Additionally, the platform is seen as a way to improve cybersecurity of critical data, while dramatically reducing data loss and mitigating the cost of breaches.

Permission-based blockchains address some of the drawbacks of public blockchains, but also sacrifice some of the potential benefits, such as wide distribution of the ledger, and a truly democratized environment without any intermediaries. The laborious consensus method, such as proof-of-work, is not considered necessary or practical in a permissioned blockchain where all parties are known. Because all parties would be identified when logged into the system, any fraudulent activity could, in theory, be fully traced and the responsible parties held accountable, so this educational element continues to provide a level of confidence that it will be a good fit for B2B.

Ultimately, blockchain is largely seen as a way to slash costs. The oil and gas industry can see reductions in cost of managing complex financial agreements, such as those governing royalties and payments, improvement in transparency through their supply chain, reduction in trade finance costs, and ultimately greater responsiveness to changing market conditions.

## Blockchain AI in Healthcare and Biotechnology

Soon after its development as the underlying architecture for Bitcoin, the concept of the blockchain was recognized as having broader value beyond enabling a decentralized alternative form of currency. For example, some organizations are beginning to use blockchain to apply advanced analytics from distributed sources without compromising the privacy of individuals.

#### Blockchain in Healthcare

There are many use cases being explored in Healthcare but let's narrow our gaze on a few of the most promising:

##### Health Records



Creating usable, high-integrity records associated with a patient despite their moving through different healthcare domains and systems is one of the great challenges of healthcare IT. Blockchain offers the possibility of creating a reliable place to track the changes across systems in a manner that gets around many of the concerns associated with data integration between proprietary systems. In effect, blockchain becomes the unifying glue that holds together a highly fragmented healthcare record.

Importantly, however, this quickly raises one of the most significant non-technical implications of blockchain: If a decentralized ledger is the source of authority, then who “owns” the rights to access “your” part of the blockchain? It makes sense for the patient to own this access. If so, the rise of blockchain could see considerably more control by patients of their data as they will (in theory, literally) hold the key.

One compelling use case is the creation of a blockchain-based Master Patient Index (MPI). MPI is a topic that aggravates most healthcare organizations as it is surprisingly hard for them to reliably track individuals as they consume healthcare from different sources. Patients names are spelled differently, addresses change, insurance providers change. Tracking and adjudicating such patient data is a constant struggle. MPI is an area of low hanging blockchain fruit, especially for the many existing Health Information Exchanges that have been established to share patient data between provider systems.

#### Tracking Drugs with Blockchain

As such, pharma companies and distributors around the world are considering options for improving supply chain security and traceability. In the last couple of years, blockchain technology has become a significant part of that conversation. The 21st century drug distribution chain has grown immensely in scope and complexity, while lagging behind in the digital technologies and management systems necessary to simplify and secure the process.

As such, there are vulnerabilities in the drug supply chain at the many points where drugs transfer ownership on their way to patients, and pharma manufacturers and other stakeholders have little visibility to track the authenticity of products. Blockchain could provide significant benefits here, with barcode-tagged drugs scanned and entered into secure digital blocks whenever they change hands. This ongoing real-time record could be viewed anytime by authorized parties and even patients at the far end of the supply chain.

#### Revenue Cycle, Reconciliation & Fraud

One of the greatest cost burdens lurking in the processes of US healthcare is the continuous tracking of the flow of services and money: The enormous complexity and distributed nature of our health system means that billions of dollars are expended annually trying to understand which patient received what service from which service provider and by whose authority. Disputes inevitably arise, and both the insurance industry and the providers of healthcare then expend a great deal of additional time and money adjudicating these disagreements.

Because of its independent architecture, blockchain could potentially form the foundation of a high integrity tracking capability that is updated in a near instantaneous manner. This would lead to many less errors (with both financial and patient care upsides) and substantially reduce fraud. Given the scale of opportunity here, this might generate enough interest to attract the investment and intellectual commitment required to solve this complex technical challenge.

#### Blockchain in Life Sciences

The direction of travel of Pharma/Biotech R&D is towards cross-organizational collaboration: The sharing of resources and insights across the borders of companies, government agencies and research institutes, is central to the development of therapies. But organizations are often reluctant to share data for fear that it gets stolen. Blockchain

offers the possibility for trust to be hard-coded into the process of collaborative R&D in a way not possible before. More trust means more collaboration and, in turn, more productivity.

Exploring the implications that are generated for individuals by blockchain, the rise of personal genomics means that patients who have their genetic code sequenced are in a position to license access to their genome (for cash or other rewards) in a way not previously possible. Therapeutic research is increasingly focused on mining the genome for information. The potential for blockchain to be used as the backbone for licensed access to an individual's anonymized genetic sequence is one of the patient-empowering edge cases that might well move center stage sooner rather than later.

## Blockchain AI in Media, Entertainment & Leisure

To envision potential markets that are ripe for disruption in media and entertainment, you have to think of ones where participants would benefit from both security and transparency, like payments, funding, monetization, and contract enforcement.

### Royalties

It is difficult to pay fairly for creative work in a digital world where it is easy to share and distribute copies, so royalty payment mechanisms are ripe for disruption. For example, music streaming sites and rights holders struggle to agree on compensation for trillions of song streams, leading to legal fights.

The Open Music Initiative (OMI), composed of 200 members including the three major labels Sony, Music, and Warner, as well as YouTube, Netflix, Spotify, and Viacom, seeks to modernize royalty payment mechanisms. The vision? A transparent blockchain-based ledger that contains music assets and their rights holders. Smart contracts can then automate royalty payments based on a song's consumption, including streaming.

### Crowdfunding of Creative Productions

2017 marked the uprising of blockchain start-ups across industries, often funded with initial coin offerings (ICOs). ICOs use cryptocurrencies like bitcoin to crowdfund new ventures.

A blockchain-based crowdfunding platform can securely record funding transactions that are transparent to all investors, allowing them to know real-time where they stand in the pecking order. Upon sale, licensing, or consumption of a creative asset, smart contracts can then automate payments to both rights holders and investors.

### Digital Advertising

Despite the ability to target and personalize ads, the digital advertising ecosystem is pretty inefficient and opaque, to the extent that 40-70% of ad dollars can go to intermediaries. Developed in partnership with Nasdaq, NYIAX recently deployed a blockchain-based ad exchange platform that allows publishers and advertisers to efficiently trade advertising contracts. MadHive is also deploying an ad exchange targeting digital video content sites.

### Distribution

Piracy is one of the main headaches that digital distribution brought to media and entertainment. Blockchain technology can enable more frictionless monetization of content to better compete with pirates. The key is to seamlessly match the legal user with the legally-purchased content, so that the payment mechanism is efficient and it is easier to compete with pirates, which by design don't process payments.

## Blockchain AI in Government, Education and Social Services

It is the robust functionality of blockchain technology that has caught the eye of government all over the world. With many countries constantly competing against each other in the innovation and technological advancement theatre, no one wants to be left behind. Many governments are either studying numerous potential blockchain-based applications for affairs of state or already in the process of testing such applications if only on a small-scale. Blockchains have the potential to revolutionize the activities of government. The potential use cases of blockchain technology in government include:

1. Healthcare
2. National Identity Management Systems
3. Tax and Internal Revenue Monitoring
4. Voting
5. Secure Banking Services etc.

### Governments that are Already Adopting Blockchain Technology

#### Dubai

Dubai has a number of big dreams for the future: flying taxis, self-driving vehicles, and actual, literal 'robocops'. The government even has a ministry dedicated to the adoption and implementation of artificial intelligence. The city government hopes to become the first-ever blockchain-powered government by the year 2020. The main aim of the plan is to leverage the power of blockchain technology in facilitating license renewals, payment of bills, and visa applications.

Dubai is a prominent holiday destination with millions of tourists and visitors every year. A lot of manhours are dedicated to processing an estimated 100 million documents every year. By using blockchain technology for these tasks, a large percentage of those manhours can be saved which translates into huge government savings. By making the move to a paperless transaction system that is hosted entirely on the blockchain, the Dubai government could potentially save up to \$1.5 billion per year.

#### Estonia

The government of the Eastern European nation of Estonia was one of the first to adopt blockchain technology for government use. Right from 2008, the Estonian government has actively been trying to develop sustainable blockchain-based solutions for many government activities. From the year 2012, it began to implement blockchain technology in a number of government activities.

The first area of adoption and implementation was in the country's registry database across several sectors such as security, legislative, health, and the judiciary. The government also created ID-kaarts, a blockchain-based national identity management system. ID-kaarts has been able to reduce bureaucratic red-tape and improve the timeliness and quality of government service delivery to Estonian citizens.

#### Gibraltar

The government of Gibraltar stole a march of many other countries in the race to be the global hub for blockchain-based fintech companies. The Government through the Gibraltar Financial Services Commission (GFSC) issued a ruling that effectively grants licenses which allow blockchains to be used as conduits for the storage and transfer of digital assets. This license is essentially the same sort of license that banks have.

The country is also one of the first to approve a blockchain Exchange. The Gibraltar Blockchain Exchange (GBX) is a subsidiary of the country's stock exchange framework. The GBX allows for the integration of blockchain technology with the country's trading and settlement system.

#### United States

On a state level, Illinois recently launched a trial of their proposed birth registry and identification system that will be powered by blockchain technology. The aim of the project is the individualization and enhanced improvement of the security of identities.

On a national level, the major interest of the US Federal Government is in the area of national security. The Pentagon and DARPA are believed to be seriously working toward adopting blockchain-based protocols in enhancing the security of the United States. Both the Pentagon and DARPA are reportedly focusing their attention on the theoretical immutability of the blockchain and how it can be applied to designing robust security protocols. Top of their agenda is the use of blockchain in sending and receiving encrypted intelligence information without the threat of interception or hacking.

These are just a few examples of some of the blockchain-based applications being pursued or implemented by various governments from around the world. Blockchain technology continues to be an interesting proposition for many governments. Blockchain technology is definitely here to stay and governments are most likely going to be trying to outdo one another in the hopes of creating superior blockchain applications.