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ABSTRACT

Blockchain is an emerging technology that is already beginning to transform business models, and is a topic about which information systems scholars and teachers need to become more knowledgeable. This essay summarizes blockchain technology and discusses several use cases where organizations implemented blockchain solutions for issues that have had a long history. We then summarize our findings from across these cases and offer some research suggestions.

Keywords

Blockchain, distributed ledger, decentralized ledger, use cases.

INTRODUCTION

With the entrance into the Fourth Industrial Revolution, "blockchain" seems to be a buzzword everywhere. Just as the Internet once did for communications, blockchain technology has gone from abstract to practical reality as a powerful way to record and manage data. In short, a blockchain is a decentralized and distributed digital ledger that is used to record transactions across many computers, or entities, making it nearly impossible to alter. By using a blockchain, many entities can write entries into a record of information, allowing a community of users to see and control what information is recorded. Essentially, it a digital chain of encrypted, time-stamped blocks of transactions, linked in chronological order (Vaughn, 2016). This paper explains blockchain at a high conceptual level and then summarizes several instances of blockchain use cases, several of which are based on interviews with the blockchain instance founder. We then summarize our findings from across these cases and offer some research ideas.

SUMMARY OF BLOCKCHAIN

Recently blockchain has become an absolute buzzword – known by many, understood by few. At the most basic level a blockchain is a collection of data structures, algorithms and encryption functions. These are fused together tightly to create this new data structure.

Starting with the basics, data are permanently recorded within a network through files called blocks. According to Gupta (2018, p. 3), "Blockchain is a shared, distributed ledger that facilitates the process of recording transactions and tracking assets in a business network. An asset can be tangible — a house, a car, cash, land - or intangible like intellectual property, such as patents, copyrights, or branding." Note that there is no central administrator or centralized data storage of the ledger because it shared across multiple sites, companies, persons, etc. Therefore, there is no one single entity in control. Essentially, a decentralized and distributed ledger is nothing more than a shared ledger.

Most likely, one has heard the words blockchain and Bitcoin used side by side, given that blockchain is the distributed ledger used to record transactions of the Bitcoin cryptocurrency. However, blockchain can be used for so much more than just financial transactions. Indeed, blockchain technology is being applied to a myriad of fields, including healthcare, entrepreneurship, voting, supply chain, fashion, and more.

While not everyone is into the idea of trading cryptocurrencies or buying into the Bitcoin hype, overall, people in many different industries seemed to have "jumped on board" with the idea of blockchain and blockchain technologies. However, there are still many exploring the ideas, as well as the pros and cons, of this "revolutionary" idea. According to Halaburda (2018, p.27), "most of the suggested benefits of blockchain technologies do not come from elements unique to the blockchain." Halaburda further argues that the three main benefits of blockchain technology are actually all separate concepts and do not need blockchain to exist. The concepts she focuses on are smart contracts, encryption, and distributed

ledgers. While she admits that they are all beneficial, she aims to stress the point that they do not need blockchain to function, and that they have been around for many years prior. For example, Halaburda says, "an automated recurring payment that someone sets up with his or her bank or a limit order with a stock exchange are examples of smart contracts." The key difference is that these smart contracts were done on centralized system rather than a decentralized system. Halaburda personally sees the idea of blockchain technologies to be much more fitting for systems like Bitcoin and does not necessarily believe the blockchain revolution will mean true blockchain technologies for the world. While there are people who argue that things like smart contracts, encryption, and decentralized ledgers do not need blockchain to function properly, it is clear that they can indeed be enhanced by using blockchain.

One main goal of many use cases for using blockchain is to deter fraud, which is a possibility whenever any transactions are conducted between parties. While there are the obvious risks in terms of identity theft and money being absconded, many businesses and organizations also deal with the potential for counterfeit products and goods. "The typical organization loses five percent of revenues to fraud each year, according to a study by the Association of Certified Fraud Examiners" (Mauri, 2017, p. 1). Fortunately, various features of blockchain have the ability to assist in deterring fraud. In addition, regardless of the "type" of fraud, the use of blockchain technology has become absolutely revolutionary for such issues.

BLOCKCHAIN USE CASES

In order to better understand how blockchain is actually being used by real organizations with a variety of business models, we present summaries of use cases from six industries. Although each is quite unique (such as in government), one pattern we observe seems to be that these people or organizations have been in the industry space for decades and tried for more than 10 years (prior to blockchain even being in existence) to find some sort of solution to their problems.

Diamond Industry

Since blockchain and blockchain related companies are in their very beginning stages, the possibilities are still vast. However, a number of reputable companies have come to surface in the past few years when it comes to blockchain used to counterfeit fraud. Everledger is one of the most successful to date. Everledger is a startup that uses blockchain technology to assist in the reduction of risk and fraud for banks, insurers, and open marketplaces (everledger.io). Leanne Kemp, CEO and Founder, recognized the potential of blockchain technology in assisting with counterfeit goods after her many years of experience in the diamond industry. In a recent interview, Kemp (2018) discussed how there was approximately $5 billion dollars in fraud annually in the diamond industry due to some parties tampering with the diamonds and their associated synthetic alternatives. As synthetic diamonds are becoming more and more realistic looking, it is almost impossible to the untrained eye to tell the difference. The core of the industry is that things are based on a handshake and a promise from a person that the diamonds are real, and there is no genuine way to determine if these diamonds being sold are truly legitimate.

In 2015, Leanne Kemp decided to take the initiative to put diamond transactions on a blockchain. By tracking and tracing every single step of a diamond's journey through its supply chain, regardless of resales and re-entering into the market, applying a system that is completely transparent and unalterable is a much more assured way of limiting the historic issues with fraud. Kemp's efforts were to digitize those steps of validations - figuring out how to identify each unit better and faster by doing it digitally, especially with diamonds crossing borders so frequently. Essentially, the goal was to parallel what the technology does with the already set human protocols in place, for that is what human systems do at their very core. Today, the expected benefits is $60 billion globally, when including all types of luxury goods. Moreover, given its success with diamonds, Everledger has now taken on many different anti-fraud markets for other products.

Fraud is not the only issue in the diamond industry. Back in the early 2000s, the United Nations got involved in the industry due to so called "blood" diamonds (also known as "conflict diamonds" due to the areas where they are produced being controlled by rebel forces), and the Kimberly Process, uniting 81 countries, was created. "The Kimberley Process (KP) is a multilateral trade regime established in 2003 with the goal of preventing the flow of conflict diamonds" (Kimberley Process, 2019). To address this, many years later, Everledger's Diamond Time-Lapse Protocol was created to enable the core infrastructure set forth by the Kimberly Process. The Diamond Time-Lapse Protocol is a "traceability initiative built on a blockchain-based platform for the diamond and jewelry industry. The aim is to engage all industry participants including manufacturers, retailers and consumers to know a diamond's story from the origin to the end customer" (Diamond Time-Lapse, 2019). This solution is integrated with IBM Artificial Intelligence and now, just three years later, over two million diamond transactions have been encrypted on its blockchain.

Wine Industry

Chai Vault, an unprecedented solution for securing the authenticity and provenance (a record that traces the ownership history) of wine fine, aims to solve the problem of counterfeit bottles in the industry. Maureen Downey, CEO and Founder, has created The Chai Method, which is certified on the blockchain and creates a permanent, digital record of provenance that can be accessed throughout a bottle's entire lifetime journey - regardless of how many times a bottle re-enters the wine (or wine auction) market.

One might wonder why blockchain is a solution for this problem. As Downey (2018) simply described, "any single layer technology can be counterfeited… trust is how people get [ripped off]." For years, she has explored other options including QR codes, which can be duplicated and proof tags, which can be 3D printed and do not give any transparency. "All prior solutions," she shared, were "just single layer solutions that, for the most part, is a visual assurance." Blockchain, however, is an immutable, distributed ledger, that is timeless.

Downey took the counterfeit wine problem to the next level. She started looking at a forensic level – what paper the labels were made of, who the glassblowers were, etc. As someone who manages collections/buys a lot of wine, it was obvious there was a huge inefficiency in the wine industry. Downey wanted to find some way a bottle could be authenticated one time and have that count moving forward, so the labor only had to happen once. She wanted to be not only be able to demonstrate a bottle's authenticity, but also a bottle's provenance - for as she said, "authenticity is nothing without provenance." Downey had been looking for a long-term solution that could share the provenance and authenticity with potential buyers prior to buying. The first bottle of wine, a 2001 vintage Margaux, has now been successfully certified and secured on its blockchain (Chai Consulting, 2019).

Healthcare Industry

Aside from the wine, diamonds, and other consumer products, the blockchain use case pattern seems to follow suit in other fields and divisions. For example, consider the ever-complex healthcare industry. For decades, underlying problems have seemed unsolvable in the realm of health and medicine. Take, for example, medical data management. According to Orcutt (2017), there are over 26 EMR (electronic medical record) systems being used in the city of Boston alone – each with its own language for its data. The inconsistencies and inefficiencies of the current configuration has cost money and has even cost lives.

Currently, as patients move between providers, their Electronic Health Records (EHR), EMR, and other data become scattered among multiple organizations and platforms. Since providers are the ones who typically hold all of this information within their various systems, one can imagine this causes issues and hurdles for the patients to overcome – including distributing the data, correcting errors, and viewing reports. Now, if everything were to be kept in one database (ledger) and distributed as needed (after authorization by the patient), it would be easier to avoid these problems and inconveniences. Fortunately, blockchain systems are now being designed to handle the patient's entire lifecycle. This includes, for example, if a patient were to move and switched doctors. Storing the records on the blockchain allows for seamless transition.

Democracy and Social Identity Industry

Our discussion continues with societal issues that seem to have had little to no luck with the current solutions, such as democracy. For centuries, the world and many of its nations have survived and thrived on democratic traditions. Since fifth century in Athens, the foundations of democracy have remained relatively firm, while the environment around has evolved. However, even today, one of the central goals of democracy remains unstable – informing those to create better collective decision making.

"If democracy was designed with today's technology, what would it look like?" This is the central focus of Horizon State, a blockchain-based voting platform. Essentially, Horizon State makes use of a digital ballot system that is based entirely within a blockchain. As Horizon State founder, Jamie Skella, noted, "This record of participation is decentralized – not owned by any government, institution, or individual – it is owned by the people."

The architecture of Horizon State is concise and effective. Users can cast their votes directly via the platform, and the votes are recorded onto Ethereum's public blockchain. For conducting verification checks on each user, there is a small processing fee paid to the developers. Each vote is sent directly to a specific campaign ID. Moreover, there is no identifiable data being involved in the transaction, making it completely secure. This is ideal for places that may harm or kill people for their opinions. On a large scale for national politics, it is required of authorities to check user backgrounds against the official

electoral roll. If the election platform is being used for something small, access could be granted to a specific group or people based on criteria that would make them eligible. As of now, Horizon State's platform is in partnership with the United Nations, socio-religion organizations, and even in the United States.

Renewable Energy Industry

As another example that appears to have been a struggle for years, consider the renewable energy sector. It is no doubt that solar panels and wind turbines bring some significant benefits to society, but the expenses and extra efforts required often deter people from regularly changing their lifestyles and actually using these resources. This is where Power Ledger fits in. Power Ledger is one of the world's leading peer-to-peer marketplace for renewable energy. In a true peer-to-peer market, such as energy trading, there should never be an intermediary who dictates terms/conditions or takes the cut of the payment. This is why Power Ledger has chosen to use blockchain as their platform.

According to Power Ledger (2018), out of $11.4tn spent on electricity generation, $7.8tn will be invested in renewable energy by 2040. Currently, the power imbalance between consumers and centralized power authorities results in a significant cost of energy security (in terms of lack of control, certainty, and economic independence for the consumer). Henceforth, this is why the renewable energy revolution needs to be moved into a mainstream model that allows for every day energy trading by every day citizens. This is what the Power Ledger Ecosystem provides.

Food Supply Chain Industry

In the past decade especially, the question of what is in food has often crossed most consumers' minds. In a survey commissioned by Trace One (2015), 62 percent of consumers in the United States said they are not provided enough information on what is in their food or where it comes from. Ninety one percent of those consumers reported that it is at least somewhat, if not very important, that they know where their food comes from. Yet, there has not been a solid solution to actively accomplish this – until, once again, blockchain.

Aside from the big powerhouse food supply chains like IBM collaborating with Walmart (IBM Food Trust™, 2019), certain niches are getting much more specific. Cargill, the largest private company in the US ($114.7B in revenue) and known for being the biggest supplier of Thanksgiving turkeys annually, launched their Honeysuckle White Traceability program as a means of creating "farm-to-table" at scale. They now allow consumers to learn all about the farm where their turkey was raised, the farmers who raised them, and more (Honeysuckle White, 2019).

Essentially, the program tracks each bird from the farm, through processing, and all the way to the retailer. Each Honeysuckle White turkey has an identification code, which can then be entered into a website. From there, the consumer can see the specific farm that raised that exact turkey. This includes information about the farmers, the conditions, the quality, and more, with the goal being complete transparency. It is a way for consumers to feel more connected to the American farmer and allows the food consumers to have transparency in the food they are serving not only themselves, but also their families. From the farmer's perspective, it gives them an outlet to show how hard they work and the effort/care that goes into getting their product to the table.

DISCUSSION AND FUTURE RESEARCH OPPORTUNITIES

As we look into these cases in aggregate, we note a few common dimensions that need to be considered if a blockchain solution is to be successful. These include business models with needs for transparency, complete security, peer-to-peer frameworks, and/or anti-fraud initiatives seeking solutions that centralized ledgers (e.g., organizational databases) cannot currently provide.

In addition to this current study, we recognize that there are numerous research opportunities for scholars looking to learn and inform more about Blockchain. For example, detailed case studies would be ideal to generate more data about benefits (e.g., ROI), costs, incentives, impediments, lessons learned, business models and blockchain use cases. Another opportunity would be to try to better understand governance models to build on Beck, Muller-Bloch and King (2018) who argue that blockchain economy companies should typically be decentralized, technically enacted, and have incentive alignment (on the three dimensions of decision rights, accountability and incentives). Their contention could also be tested in one or more case studies.

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