Department of Business and Management
Chair of Organizational Design

Blockchain technology: drivers influencing a successful implementation for business

SUPERVISOR
Ioannis Kallinikos

CANDIDATE
Filippo Mitchell Cox
707371

CO-SUPERVISOR
Luca Giustiniano

ACADEMIC YEAR 2019-2020

Contents

Introduction

This study is the final result of a two-year master's program in Management with a major in Entrepreneurship and Innovation at LUISS University. These years, thanks to professors and colleagues and for the internship and Exchange experience, allowed to gain a lot of experience and knowledge that will be useful for the future.

During the program, it was taught how is important to understand and acquire the skills that are requested to enter the professional world. Also, an important quality that was taught is curiosity. Curiosity of exploring new and poorly understood topics, challenging oneself to get lost and to find the right path to achieve the final goal. Trying to use those knowledge and experience to recognize a problem and to add useful insights to it, so that the human knowledge can keep evolving.

Placed against this backdrop this thesis deals with blockchain, which is a relatively new and not well understood technology which has been quickly developing and changing. The aim of the study is to explore its world (the history, the functioning, the applications) to analyse what the organizational implications are, irrespectively of the company's industry. Generally the public sees blockchain as an absolute solution that can be used in every situation to improve tasks and make them more efficient. Beck and Müller-Bloch (2017), consider blockchain as a radical innovation, capable of disrupting existing business models and "also risky since such fundamental technological changes require to adapt old or develop new organizational competencies to perform differently."[1] When handling a radical innovation, it is indispensable to "prepare the ground" before planting the seeds. In order to understand how to prepare the organization to bear radical change, it is important to explore and comprehend what these changings are and when they have to be applied.

More in detail, this study will concern the organizational side of the blockchain technology. It will try to make the reader aware of what are all the implications connected to an implementation and what are those conditions and factors on which

[1] Beck, R., & Müller-Bloch, C. (2017, January). Blockchain as radical innovation: a framework for engaging with distributed ledgers as incumbent organization. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.

the success or fail of projects depend on. The author believes that in order to understand what these implications are is imperative to clearly discern the underlying logic and the reason why it was invented; it is also fundamental to clarify how it is currently used in companies to identify what are the possible benefits deriving from it and what are those situations in which a blockchain project can be successful.

The structure of the study will reflect this belief and will drive the reader through the process that brought the blockchain products in the business world and at the end will give a clear and straightforward understanding of its organizational implications. The structure is the following:

1. The blockchain: in the first chapter a detailed and broad explanation of the history and the functioning of blockchain will be given. It starts with the discussion about its origins in 2008 and starts a schematic explanation of the technology by its key elements. After, the functioning will be explained as explained by its inventor, Satoshi Nakamoto. The last part is focused on the support of smart contracts with Ethereum and on permissioned and permissionless blockchains.
2. Blockchain 3.0 and its applications: the second chapter will explain the process that brought distributed ledger technology in the business world, usually referred as Blockchain 3.0. It has many applications in different industries. This chapter aims to explore what are the main industries that are investing in blockchain and explain how they are using it. In particular, the focus will be on the financial, agri-food, governments and logistic industries and for each of them an example will be explained in detail.
3. From this section the focus will switch to the study on the organizational implications of blockchain. Here the method and the data collection technique will be explained.
4. In the fourth chapter the literature regarding the conditions and factors involved in a blockchain project will be reviewed. In particular, three studies will be used. In order to make the findings clearer and more straightforward, in the end they will be grouped in four categories.
5. In the last chapter the findings from the literature will be enriched through data collected with interviews. The interviewees are experts of the FinTech

industry, with a focus on blockchain. After that, there will be a brief digression on the future of the system trying to answer at the following questions: which applications will survive? Which once will be abandoned? What are the trends that will be seen in the following years? At the end the four categories from the previous chapter will be then updated using the data from the interviews. This will make the findings of this study more complete and broader.

This said, the study will answer to the following research questions:

1. What are the industries that invested the most in blockchain and what are its most important business applications?
2. What are the issues and factors that have to be taken into account before and during a blockchain implementation project?
3. What might be the future of the blockchain technology in business?

1 - Blockchain

1.1 What is Blockchain

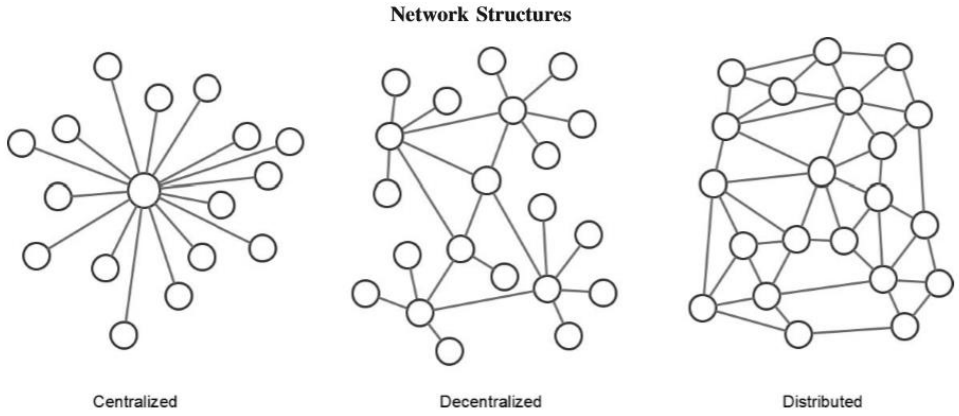
The blockchain technology was introduced in 2008 by a mysterious person (or group) that goes by the name of Satoshi Nakamoto. He/she/they wrote a paper called "Bitcoin: A Peer-to-Peer Electronic Cash System", about "an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party."[2]. It was this revolutionary currency system known as Bitcoin, that with the use of a new technology called blockchain, replaced trust with a system in which the users did not have to know each other and so didn't have need for a central authority to guarantee all the transactions.

[2] Nakamoto, S. (2019). Bitcoin: A peer-to-peer electronic cash system. Manubot.

An important specification must be made regarding the terminology which can be confusing to the casual audience. Both the terms ‘Bitcoin’ and ‘blockchain’ can be used as terms to describe: the blockchain technology at the core of the cryptocurrency, the protocol, or the cryptocurrency itself.

The concept is well expressed by the name itself, blockchain. This is a series of blocks, each of which contains information that are connected to one another to form a chain. Before being added to the chain, each block needs to be verified and validated by the nodes (i.e. users). The peculiarity is that with blockchain the users are incentivized to check the validity of the information that is going to be added to the chain. Once the consensus is reached and the block is verified, it will be added in chronological order to the chain. In section 1.3 the blockchain related to Bitcoin will be explained more in details.

At the core of the technology there is a digital ledger characterized by several important principles that make it such a unique technology. First, the ledger is distributed. As Figure 1 shows, a decentralized network is characterized not only by the fact that there is no central authority, contrary to what happens in a centralized one, but all the users are connected to each other. In the case of blockchain, that means that all the users have not only access to the entire database but also the complete history of all the data included in the ledger. This is the case of Bitcoin, which, as it will be explained later, is not regulated by any kind of central bank. Consequently, this technology is based on peer-to-peer transmissions, because all the transactions between users are direct and not channeled through the central authority. Next, the transactions are irreversible, meaning that once it is entered in the ledger it cannot be changed by the users.



Source Figure 1: Kokina, J., Mancha, R., & Pachamanova, D. (2017). Blockchain: Emergent industry adoption and implications for accounting. Journal of Emerging Technologies in Accounting, 14(2), 91-100.

1.2 Consensus Algorithm

As mentioned before, for the blockchain to be modified (add a new block, eliminate or replace an old block), all the users need to find an agreement on whether the information is reliable or not. This concept is called consensus algorithm. There are different kinds of consensus protocols, examples of these are the Proof-of-Burn, Proof-of-Weight and Proof-of-Activity. In the case of blockchain there are two other types that have been chosen: Proof-of-Work (PoW) and Proof-of-Stake (PoS). The kind of protocol used generally depends on the application of each specific blockchain.

An example of the first kind of protocol is the one used for Bitcoins. For the understanding of the concept of PoW a step back is needed. When a block is added to the chain it needs to be solved. In brief, the addition of each block requires the resolution of a complex mathematical problem and this process needs a lot of calculation power. Essentially, with the PoW protocol this solving problem process is a task given to the users of the network, called miners, and the once that manages to solve it receives a prize in the form of cryptocurrencies. The main objective of PoW is to prevent cyber-attacks. In fact, this protocol is very hard to attack because,

in order to insert a malicious block, someone would need to have more calculous power than the rest of the user put together, basically the 51% of energy of the whole network (i.e. 51% attack), and this would require a very big amount of energy and money. This kind of protocol will be discussed more in details in the next section.

The second kind, that will be implemented instead of the PoW protocol by a blockchain based platform called Ethereum, has a big difference with the PoW: it does not require the use of much power of calculus to create a block. In this other case, the users of the network, called validators, will not have to solve the mathematical problem but they will set a stake and, based on this stake, an algorithm will chose only one of them to have the chance of verifying and validating a block. To compensate the validator, it will receive an interest on the transactions. There is no limit to the number of validators that can be selected at the same time, but the interest will be lower to disincentivize them to complete the task. A big concern is about how safe this protocol is, in fact PoW has both technological and economical protection. With PoS the form of protection is related to the stake itself: in case of an attempt to attack the protocol, the validator responsible for the act will lose its deposit, that can amount to thousands of dollars.

1.2.1 pros and cons of PoW vs PoS

In this section the focus will be on the pros and cons of the two more used consensus protocols to understand which of them is more fit for a specific use or situation.

Pros of PoW protocol:

1. More decentralized: a network based on a PoW protocol allows everyone who has a computer to mine blocks, and this makes it extremely decentralized.
2. More secure: due to the mining process, adding a malicious block is very hard.

Cons of PoW protocol:

1. Requires a lot of energy: due to the difficulty of the math problem that needs to be solve in order to mine a block, a lot of energy is used during the process.
2. Wastes a lot of computing power: same reason as above.
3. Scalability: with the growth of the network more nodes will be required to validate a transaction, so the scalability reduces.
4. Transaction throughput: the harder the math problem becomes the more time is needed to solve it.

The PoS protocol is thought to solve all the issues related to a PoW protocol.

Pros of PoS:

1. More energy efficient: with the elimination of the math problem solving, there is a big reduction of energy requirements
2. Higher rewards: when a valid block is successfully, added the user who checked it will receive a higher reward in the form of a transaction fee
3. Scalability and transaction throughput: these issues are solved through the implementation of sharding, a database management concept where separate partitions of the database are stored in separate server instances, improving the performances.

Cons of PoS:

1. Less decentralized: because a cryptocurrency stake is involved in the process, only those who can afford having more of them get to validate more transactions.
2. Less secure: if a staker stakes a very big quantity of cryptocurrencies for a long time he/she can validate many transactions and can validate wrong transactions.

Until now PoW protocols have been used and tested more than PoS once and even though it makes the blockchain network fully secured, it has issues with scalability

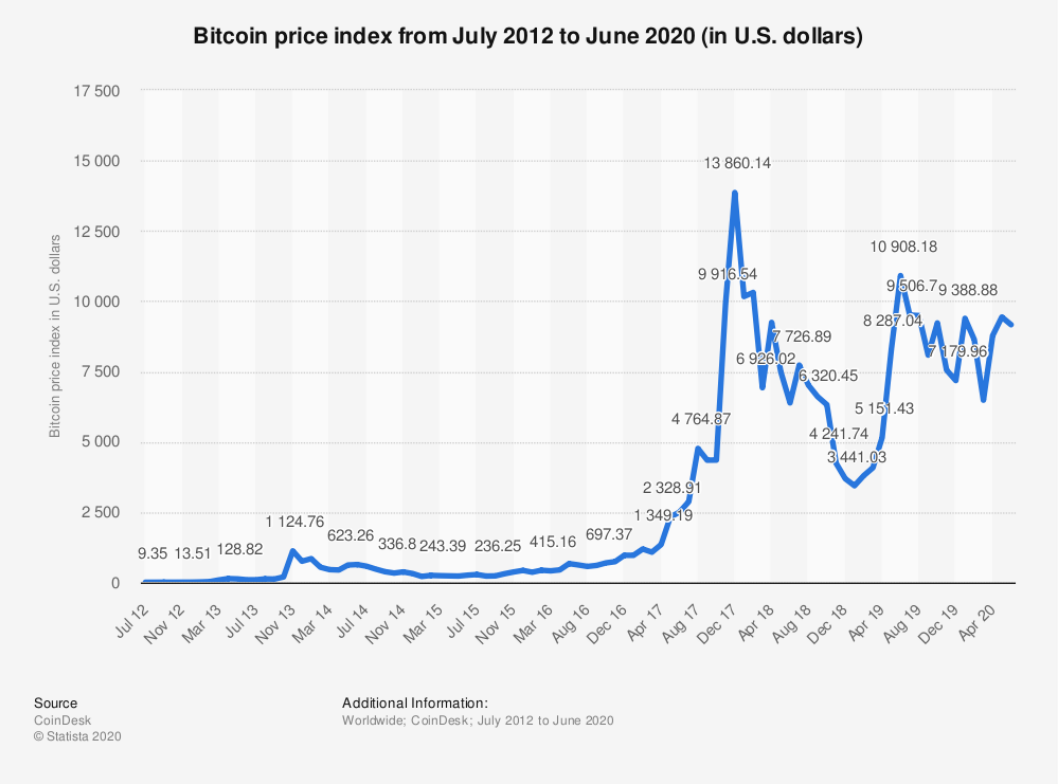
and transaction throughout. In addition, mining is becoming more and more controlled by centralized companies, and the cost of all the required energy is not sustainable. On the other side, PoS algorithm is less secure, stakers have their own cryptocurrencies at stake, making the security still reasonably high. Said algorithm also solves all the scalability and transaction throughput issues.

The future will strongly depend on the successful transition of Ethereum from PoW to PoS. If such a famous network widely used by the new blockchain start-ups Can switch to PoS whilst remaining highly secure it will convince the bigger blockchain-crypto community about the solidity and safeness of the new PoS algorithm.

1.3 The example of Bitcoin

The first application, and until now one of the most successful, of a PoW protocol based blockchain is Bitcoin, the famous cryptocurrency that was launched right after the paper published in 2008 through a platform for Bitcoin transactions and the issue of the first Bitcoins. The reward for the first mined block, called genesis block, was of 50 bitcoins and the first transaction in history was between Nakamoto and Hal Finney, a computer games developer, who received 10 bitcoins as a test. At its early stages the system had many vulnerabilities, one of which led to the production of 180 billion bitcoins that were successively deleted from the blockchain and led to consequent updating of the security system.

The cryptocurrency has been characterized by a very volatile price since 2012 and 2013. During this year, its price started increasing reaching the value of $1.124 on November. After that, the price started slowly decreasing, until December 2016, when it started its incredible rise to a value of $13,860 on December 2017. Because of the fact that it is exchanged on non-centralized independent exchanges, like Coinbase, the price may vary platform to platform. Figure 2 shows the price of Bitcoin in U.S. Dollars from 2012 until 2020.



Source Figure 2: Bitcoin price index monthly 2012-2020 | Statista. (2020). Retrieved 28 July 2020, from https://www.statista.com/statistics/326707/bitcoin-price-index/

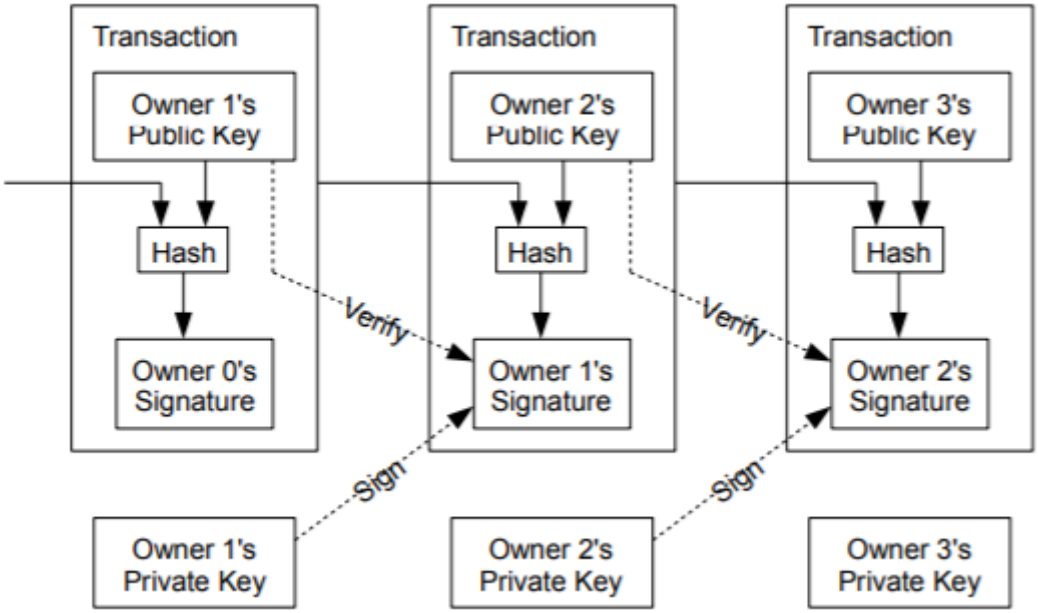
Before explaining how Bitcoin work the principal terminology will be explained:

- Block: is a set of transactions added to the blockchain.
- Transaction: is a collection of data. In Bitcoin this data is about the amount being sent, the origin account and the destination account.
- Node: is a computer that runs the Bitcoin program. Different nodes are connected together to create a network.
- Block hash: is like a "fingerprint" in a form of a number that identifies the specific block in the blockchain.
- Memory pool: is a temporary storage for new transactions received by a node

Bitcoin's technology is the first one to solve two issues that affected every other attempt of digital cash: the double-spend problem and the Byzantine generals'

computing problem. The first problem is connected to the absence of a central authority in the process. In fact, not having a trusted part in the process brings the issue that an owner of a coin could spend said coin twice (or more times) without the others knowing it. The second problem is related to the fact that in order to have the process working, a coordination communication mechanism between parts that do not trust each other is needed.

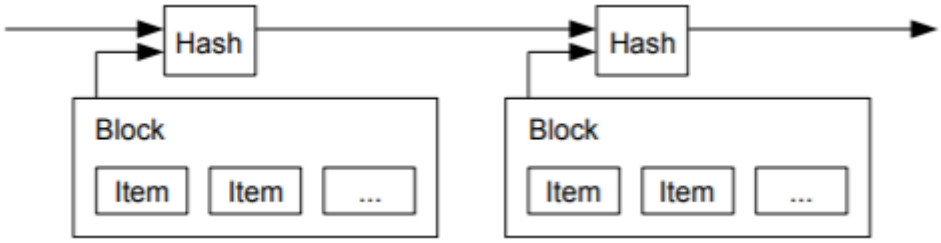
The process through which these issues are solved starts from the transactions. Every coin, states Nakamoto, can be considered as a succession of signatures of all its owners. He continues saying that "Each owner transfers the coin to the next by digitally signing a hash of the previous transaction and the public key of the next owner and adding these to the end of the coin."[3] So that every user can check the signatures on the coin to verify all the previous owners. This process is graphically explained in Figure 3.



Source Figure 3: Nakamoto, S. (2019). Bitcoin: A peer-to-peer electronic cash system. Manubot.

[3] Nakamoto, S. (2019). Bitcoin: A peer-to-peer electronic cash system. Manubot.

This first step does not solve the double spending problem, so the second step is introduced: the time stamping servers. These work by timestamping, defined as "a digital certificate intended to assure the existence of a generic digital document at a certain time."[4], so recording the time in which a transaction occurred, a hash of a block of items and then by making it public. Each timestamp includes even the previous once, creating a chain. Figure 4 gives a graphical idea of said chain.



Source Figure 4: Nakamoto, S. (2019). Bitcoin: A peer-to-peer electronic cash system. Manubot.

The idea behind this is that in a system with no trusted party the only way to make users know that a specific Has not already been spent in another transaction, is by not only making every transaction public, but by giving all parties certainty at the time of every transaction that it was agreed by the majority of the users that the coin was not already spent.

The third step is, as explained before, the PoW protocol. In this specific case the work that has to be done in order to add blocks to the chain is called "mining". Basically, a node (or "miner") will choose transactions from the memory pool and generate what is called a candidate block, then using processing power a block hash, which is like a block's fingerprint, will be generated. This hash in order to be valid needs to be lower than a set target. Once the block is successfully mined it will be

[4] H. Massias, X.S. Avila, and J.-J. Quisquater, "Design of a secure timestamping service with minimal trust requirements," In 20th Symposium on Information Theory in the Benelux, May 1999.

added to the chain and this addition will be communicated to all the other nodes of the network.

As stated in the first paragraph, additions to the blockchain are said to be irreversible, meaning that once a block is added to the chain it is almost impossible to change the order of the blocks, substituting one with a new block or delete a block. That is not entirely true. Technically, a chain can be changed, but as it will be explained, in reality it is almost impossible to do it. There are two different options with which a user could modify a blockchain: having the consensus of the majority of the nodes and the beforehand mentioned 51% attack. For how the system is thought both options are very unlikely to happen.

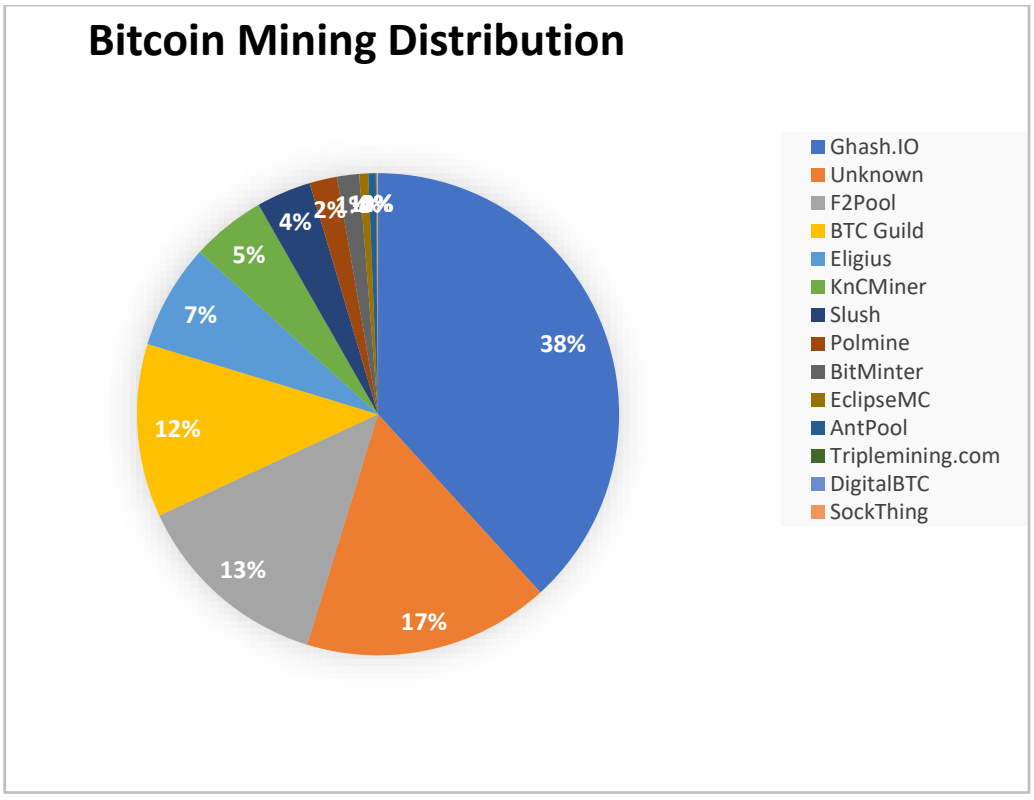
The first, because of the system of incentives. There are two different incentives involved in the Bitcoin system:

1. Reward block: when a miner that successfully mines a block gets a reward in bitcoins, and he/she will only be able to spend the reward if the chain is 100 blocks long.
2. Transaction fees: "If the output value of a transaction is less than its input value, the difference is a transaction fee that is added to the incentive value of the block containing the transaction."[5]

Considering these two incentives, nodes are moved to build the "longest known chain", considered as the only valid version of the blockchain by nodes themselves. It must be specified that the longest known chain is not the chain with more blocks, but is the one that took more effort, in terms of processing power, to be built. If these factors are taken into account, it becomes very hard for a single node or a group of nodes to convince at least half of the network's users to modify the chain, because the only way to do that is by rebuilding it from the beginning and applying the change wanted.

[5] Nakamoto, S. (2019). Bitcoin: A peer-to-peer electronic cash system. Manubot.

The second option consists in acquiring 15% of all the processing power of the network. This would be easy if the number of nodes in the network would have been low, but in the case of Bitcoin every person on the planet can join the chain. Consequently, the amount of resources needed to acquire such power is so high that is almost impossible to achieve that. Also, as the same Nakamoto states, it would be more convenient for the attacker to use that power for actually mining blocks and receiving the reward blocks and the transaction fees. For the state of clarity, it must be said that there are some miners that were very close to reach the 50% of total mining power but nobody ever successfully completed a 51% attack. Graph 1 shows the distribution of miners on the 25th of September of 2013



Source Graph 1: 51% Attack - How to rewrite the blockchain. (2019). Retrieved 24 July 2020, from https://learnmeabitcoin.com/technical/51-attack

1.4 Other Attempts of digital currency

For the sake of completeness, in this section a short digression on the history of digital cash will be made. The first form of cryptocurrencies comes from the Netherlands of the 1980s where gas stations in the remoter areas were often raided, during the night, because of the cash they were holding, so someone though of giving to truck drivers smartcards loaded with money and that is how electronic money was born. since then the world has evolved with many different new forms of electronic cash and digital cash.

During this period, an American cryptographer, David Chaum, invented the concept of "blinded cash", a different type of electronic cash that through the use of cryptography could encrypt the information passed in each transaction, making it safer and more private. The concept became reality with DigiCash, founded by the same Chaum. The company went bankrupt in the 1998 but its concept had a fundamental role in the development of cryptocurrencies.

In the 1990s' the previous concept was further developed and made successful with PayPal. This new solution allowed people to make quick and safe transactions via web. Its success comes from the decision to connect the service to the EBay community. In fact, at those times purchases made on EBay were paid through checks or money sent through the U.S. Postal Service, causing several delays. The service is still widely used around the world with about 286 million active users.

Another unsuccessful but fundamental attempt was the one of B-Money, proposed by Wei Dai, a Chinese computer engineer, in 1998. This system was supposed to be anonymous and based on a distributed network, exactly like Bitcoin a decade later. It was anonymous because to transfer money pseudonyms were used. Even if B-Money never became successful, many of the elements expressed by Wei Dai in the proposal were later used in Nakamoto's paper for Bitcoin.

One of the first, but fundamental, use of a PoW system on an electronic currency system was Bit Gold, proposed in 1998 by Nick Szabo, an American cryptographer. Similarly to bitcoin's blockchain, Bit Gold Pow protocol the solutions to the cryptographic problems were compiled and then made public. The big step that Szabo's system made was decentralization: he wanted a system that did not have to

rely on a money issuing central authority, reflecting the properties of real gold. Even this solution was not successful.

The last, and one of the most successful, pre-bitcoin system that needs to be mentioned is HashCash, proposed in 1997 by Adam Beck. This was another PoW protocol-based system, using it to generate and distribute new coins. It was born with the intent of reducing the spam mails and preventing DDoS attacks[6]. It eventually lost its effectiveness due to an incredible increase of the processing power need.

In conclusion, it can be noticed how Bitcoin and Blockchain are concepts that are a result of a long process that started in the 1990s' and that saw many different attempts, the majority of which was not successful due to many issues such as the need of a central authority, the need of processing power, security, privacy, but they have all been functional to the creation of Bitcoin and consequently blockchain as we know it today.

1.5 Smart Contracts

With the development of the blockchain technology another interesting concept could be implemented: smart contracts. This feature was first introduced in 1994 by Nick Szabo, proposer of BitGold[7], who defined smart contract as "a set of promises, specified in digital form, including protocols within which the parties perform on these promises."[8] A famous example discussed by Szabo, compared smart contracts to a vending machine, which through an automatic mechanism gives back the selected product and the change, given the price on the screen. With the same principle contracts give back an automatic action after the user "drops" a bitcoin in the "vending machine", and this can have many different applications. Technically, they can be defined as those computer protocols that help with the verification and enforcement of contracts between different users of a blockchain.

[6] A Denial Of Service Attack (DoS) is an intentional cyberattack carried out on networks, websites and online resources to restrict access to its legitimate users. Denial of Service (DoS) attacks is highly notable events that may last from a few hours to many months.

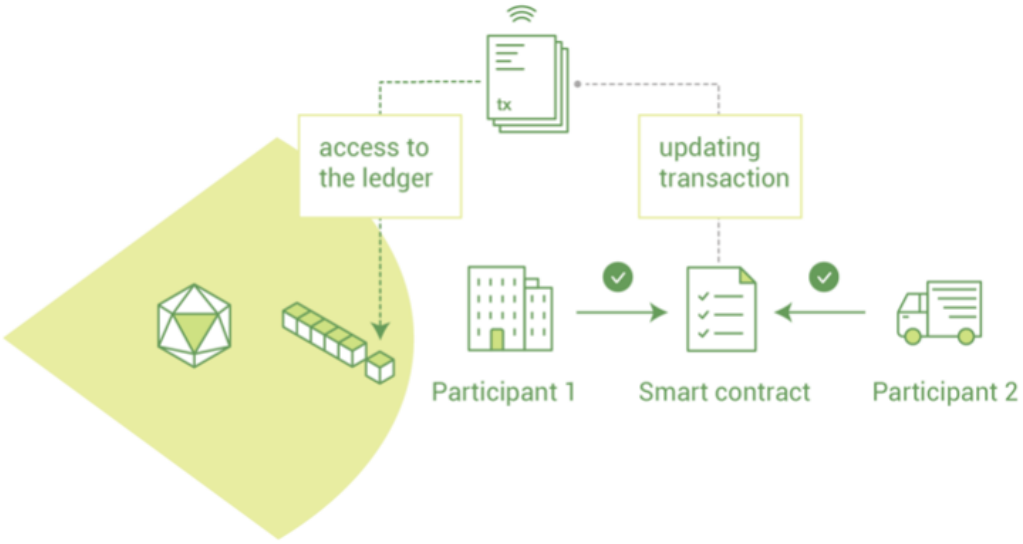
[7] See paragraph 1.4

[8] Szabo, N. (1996). Smart contracts: building blocks for digital markets. *EXTROPY: The Journal of Transhumanist Thought,(16), 18*(2).

Smart contracts together with blockchain have three characteristics:

1. The blockchain's ledger will save the program code of each contract, so it cannot be changed.
2. They can have their own cryptocurrencies or digital asset, which will be exchanged in predefined situations
3. The users that execute the smart contracts are anonymous and untrusted and they are not backed by ant third-party trusted user.

Figure 5 shows a simple representation of the concept of smart contracts. In the specific case there are participant 1, a generic company, and participant 2, a shipping company. Set the rule and terms on the ledger, the smart contract can be used to stipulate the cost of shipping of a product of participant 1.



Source Figure 5: Introduction — hyperledger-fabricdocs master documentation. (2020). Retrieved 27 July 2020, from https://fabricdocs1.readthedocs.io/en/issue-fab-7895/blockchain.html

The first blockchain that supports smart contracts is Ethereum. The system was invented in 2015 by Vitalik Buterin a programmer and writer. The peculiarity of the blockchain based platform is that it can be used to create decentralized applications, called dApps, using smart contracts. The potential of the platform is

enormous because “it can be used for anything you can write a computer program to do.”[9] More in the specific, up to now, some of the applications are:

1. Financial applications: services that allow to lend, borrow or invest digital assets.
2. Cryptocurrencies wallets: they allow users to spend cryptocurrencies or assets.
3. Decentralized Markets: they allow to exchange digital assets.

Usually it is mistaken for a cryptocurrency, just like Bitcoin, but within the platform there is a specific cryptocurrency called Ether, which works similarly to Bitcoin. Ethereum 1.0 is based on a PoW protocol, but the version 2.0 will be based on a PoS protocol. The substantial difference of Ether is that it fuels smart contracts and consequently dApps made with Ethereum. One last element of Ethereum is “Gas”. This is the unit that measures the amount of processing power needed to run a dApp on the Ethereum network. The name is used to give the idea of the utility of it: to use a car people need to go to the gas station and pay for fuel, in the same way users on Ethereum pay to have their smart contracts executed by miners.

In the next chapter the possible business applications of smart contracts will be discussed more in details.

1.6 Permissionless vs. Permissioned

The blockchains that are at the core of the applications that have been discussed since now, Bitcoin and Ethereum, are generally called permissionless, or public, blockchains. These are characterized by the fact that to become a user in the network no preapproval of a third-party is needed, so they can just join at will. All that is needed is a computer and an installed software that supports the blockchain.

Opposed to that there is the permissioned, or private, type of blockchain. In this case “members are pre-selected by someone – an owner or an administrator of the

[9] What Is Ethereum? | Ethereum For Beginners | Start Here!. (2020). Retrieved 27 July 2020, from https://education.district0x.io/general-topics/understanding-ethereum/what-is-ethereum/

ledger – who controls network access and sets the rules of the ledger."[10] This new kind of blockchain started developing in 2013, when the value of Bitcoin went above $1.000, and the public awareness started increasing. During these times different industries got interested in the topic and started studying the technology to find out if it would have been of any use for them. It was concluded that a public blockchain would have not been suitable for regulated corporations for security and privacy reasons. So that is why permissioned blockchains were invented.

According to Hileman and Rauchs (2017) these two different types of blockchain can be further divided. In their paper[11], they make a division based on three elements: "Read", which represents the users that can enter the ledger and can read the transactions, write, which represents the users that can generate transactions and send them to the network, and commit, which represents who can update the state of the ledger. Table 1 shows the result of such division, which adds to the private and the public blockchain the so called "consortium", in which the owners of the blockchain are a group of people or organizations.

[10] Natarajan, H., Krause, S. K., & Gradstein, H. L. (2019). Distributed Ledger Technology (DLT) and blockchain. FinTech note; no. 1. Washington, DC: World Bank Group.

[11] Hileman, Garrick and Rauchs, Michel, 2017 Global Blockchain Benchmarking Study (September 22, 2017). Available at
SSRN: https://ssrn.com/abstract=3040224 or http://dx.doi.org/10.2139/ssrn.3040224

Blockchain types			Read	Write	Commit	Example
	Open	*Public permissionless*	Open to anyone	Anyone	Anyone*	Bitcoin, Ethereum
		Public permissioned	Open to anyone	Authorised participants	All or subset of authorised participants	Sovrin
	Closed	*Consortium*	Restricted to an authorised set of participants	Authorised participants	All or subset of authorised participants	Multiple banks operating a shared ledger
		Private permissioned ('enterprise')	Fully private or restricted to a limited set of authorised nodes	Network operator only	Network operator only	Internal bank ledger shared between parent company and subsidiaries

Source Table 1: Hileman, Garrick and Rauchs, Michel, 2017 Global Blockchain Benchmarking Study (September 22, 2017). Available at SSRN: https://ssrn.com/abstract=3040224 or http://dx.doi.org/10.2139/ssrn.3040224

For the sake of completeness, it has to be specified that there are many other cryptocurrencies that have been created for many different purposes, which are different from the pure P2P coins like Bitcoin. According to a study[12] requested by the European Parliament and made by Policy Department for Economic, Scientific and Quality of Life Policies, the timeline of cryptocurrencies is characterized by three sections. In the first one, the early examples of cryptocurrencies, including Bitcoin, are created. Then the second one, starting in 2014, is characterized by cryptocurrencies which allows users to be completely anonymous, examples of these are Monero and Dash. Finally, the third one, starting from 2015, in which Ethereum and the use of smart contracts was introduced. These, as explained before, allows the creation of new kind of platforms and ecosystems, which are run by a new generation of cryptocurrencies. Figure 6 shows this timeline giving examples of cryptocurrencies representing each section.

[12] Houben, R., & Snyers, A. (2018). Cryptocurrencies and blockchain. *Bruxelles: European Parliament*.

Source Figure 6: Houben, R., & Snyers, A. (2018). Cryptocurrencies and blockchain. *Bruxelles : European Parliament*.

1.6.1 Pros and cons of public and private blockchain

Both public and private blockchains have pros and cons.

Pros of a public blockchain:

1. No need for trust: as it was explained before blockchain was firstly designed to eliminate trust between users. This is achieved through the incentive system and through making the ledger completely public and immutable.
2. Security: decentralization and the big number of users of public chains make them very hard to attack.
3. Transparency: because of the publicity of the ledger it is very transparent. Everyone can check all the transactions that have been recorded on it

Cons of a public blockchain:

1. Speed: one of the main issues of public chains is speed. The public ledger of Bitcoin can process only 7 transactions per second, which compared to the 24.000 of Visa, makes it very slow. The main cause is the time needed to reach consensus.
2. Scalability: because of all the users in the network, all the transaction that they generate stuck the network.
3. Energy consumption: As seen before, PoW protocols require a lot of energy and that makes it very expensive. For this reason, different public

blockchains, like Ethereum, are moving towards the implementation of PoS, which requires way less energy.

Pros of a private blockchain:

1. Speed: because of the smaller number of users the network is faster than the public one. They can in fact process thousands of transactions per second.
2. Scalability: because only a few users can manage data on the chain, more transactions can be processed.

Cons of a private blockchain:

1. Centralization: the main issue is that due to the private network that it has, it loses the main reason for which blockchain was born, decentralization.
2. Trust: the credibility of the network is related to the credibility of the users in it because they are the once validating and verifying transactions.
3. Security: because of the fewer users in the network it might be easier for a malevolent one to attack the chain successfully

As discussed before there is no better solution in general, but the environment and the ecosystem in which they are used is the element that needs to be considered. Generally, for organizations' purposes the private blockchain solution are more suitable, because usually the users are known and trustworthy and speed and scalability is needed. While for cryptocurrencies or similar purposes, security, absence of trust and decentralization are fundamental.

1.7 The tokenization in blockchain

In 2013, with the creation of Ethereum, another interesting feature was added to blockchain. This is the tokenization of assets: a token is a digital representation of any asset. Tokens can be created by anyone by using the Etherum blockchain and they can be used to interact with different decentralized applications. This kind of feature has the potential of disrupting many different industries. Through tokens a wide range of assets, different from currencies, can be digitally represented.

Entrepreneurs started understanding the great advantages of tokens and blockchain, in particular they started using them for funding their business. The funding of business with tokens is called initial coin offering (ICO). This is basically the same as crowdfunding, through which companies get their funding mostly through internet from a big number of investors who invest a small amount of capital. The difference is that in an ICO the company sells its token to the public and they are generally more global, liquid, scarce and tradable, so this makes the operation more appealing for early global investors.

There are different kind of tokens:

- Reward tokens: as the name says, these are given out generally for free as a reward to someone using a specific application.
- Utility token: they can be used for specific purposes in within the same platform from where they are released. For example, they can be used for paying for something that is offered in the same platform. Usually, they are released from companies and can be used to buy other products from the same.
- Asset tokens: these tokens are connected to a real asset like bonds, real estate gold… and represent the real value of it.
- Security/Equity token: these behave the same way as company shares and they are given to the investors after an ICO.
- Currency tokens: these are used for purchases and are basically like a normal cryptocurrency.

In a report by Deloitte[13] the benefits and challenges of tokenization.

According to the authors the benefits are the following:

1. Transparency: inside the token there are all the information about the holder's rights and responsibilities and the whole list of the previous holders. This makes all the transactions very transparent.

[13] Laurent, P., Chollet, T., Burke, M., & Seers, T. (2018). The tokenization of assets is disrupting the financial industry. Are you ready. *Inside. Triannual insights from Deloitte*, (19), 62-67.

2. Increased liquidity: liquidity is higher due to the access that tokens have to a bigger pool of investors. This is because tokenized asset can be traded on a secondary market.
3. Accessibility: tokens are highly divisible meaning that the minimum investment is low and minimum investment period is reduced because of its high liquidity. These two characteristics obviously make them more accessible to investors.
4. Improved transactions: because they are completed through smart contracts, they are mostly automated. This makes them faster and cheaper because of the reduced need of intermediaries.

On the other hand, the challenges are the following:

1. Governance: because a token is divided between a very big number of investors, these are not incentivized to bear the costs related to the tokens.
2. Safety: as any other internet related product, it is threatened by hackers.
3. Regulation: this is a very big problem with every blockchain based product because of how decentralized they are. Consequently, they might be strongly regulated, and regulation may be very different depending on the geographic location.
4. Regulatory protection: because of the possible lack of regulation over the matter scams and hacks might be incentivized.

2 - Blockchain 3.0 and its applications

This chapter will be focused on most of the applications of blockchain technology in business and which industries are investing more on it. This kind of application of the technology is referred as blockchain 3.0, to distinct it from the previous applications.

2.1 From blockchain 1.0 to 3.0

Conventionally blockchain has been distinguished in three different versions, to diversify the different applications that it has had during its history. Blockchain 1.0 is referred to its first application, which is the support of financial payment automation with no central authorities. Then, with the creation of Ethereum, blockchain 2.0 started. It differs from the first version because of the support of smart contracts and the creation of decentralized applications. Other blockchain 2.0 based project worth mentioning are Hyperledger's HL Fabric, Sawtooth, Iroha and R3's Corda.

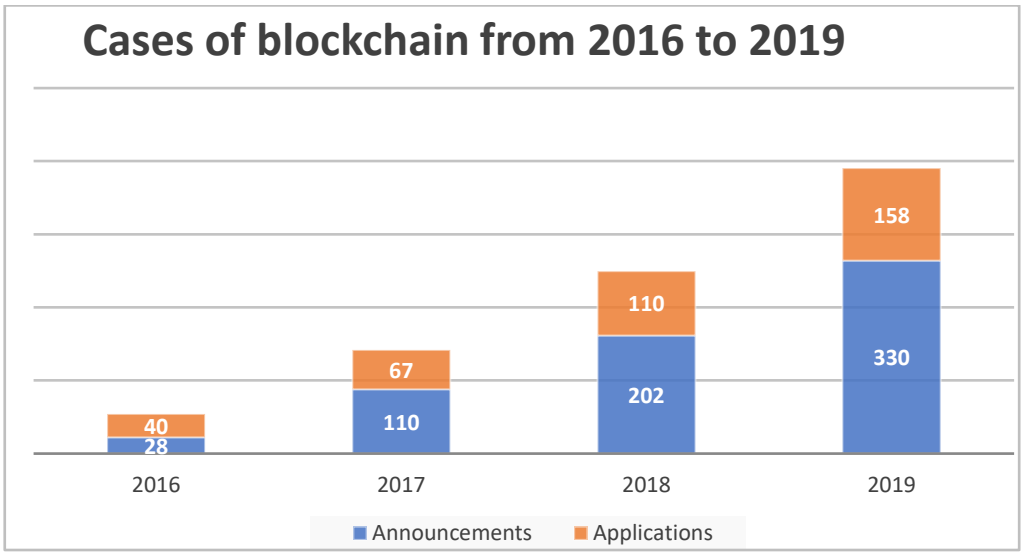
With the introduction of the support of smart contracts, the potential of the technology increased considerably. Nowadays, it is used in many different industries: healthcare, governments, education, banking, insurance, real estate and charities. These new applications are based on the so called blockchain 3.0, which is different from the other two versions because it goes beyond finance actions and asset transfer. Later in the chapter cases of each of the industries will be explored.

2.2 The development of blockchain 3.0

The blockchain 3.0 based platforms that have been developed can be divided in two different types: general purpose and application specific platforms. The first family is related to different applications like Ethereum or Libra, a permissioned platform for payments created by Libra Association, an association created by big companies such as Facebook. The second type is related to platforms which are focused on only one application. These are used for cryptocurrencies or are developed by companies as support of division, examples are IBM Food Trust for traceability of food along the supply chain, We.Trade for finance trade and Tradelens for logistics.

According to a report made by Politecnico di Milano in 2020 on Blockchain the technology is still at its early stage and there are not many cases of applications by companies: there have been only 1.045 in the last 4 years. Generally, companies are more focused on the creation of platforms rather than the actual development of the

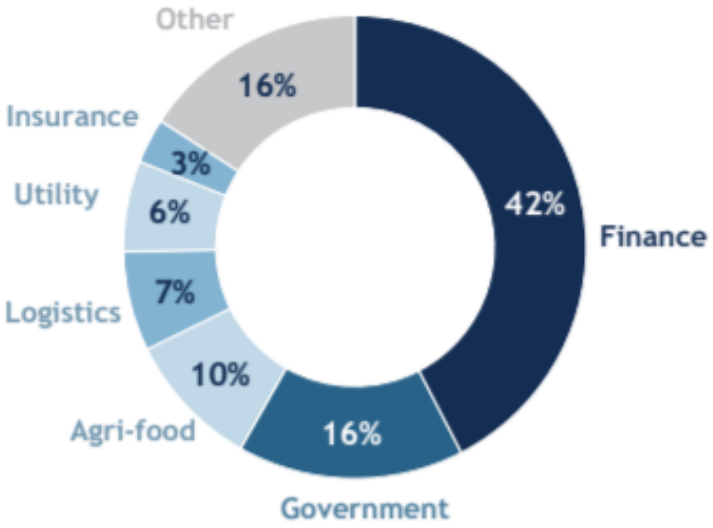
technology. As Graph 2 shows, there has been an increase of the cases of blockchain, divided between announcements and applications.



Source Graph 2: Galasso, D., Micello, E., & Erba, S. (2020). Blockchain & Distributed Ledger: Unlocking the Potential of the Internet of Value. Osservatorio Blockchain & Distributed Ledger, Politecnico di Milano.

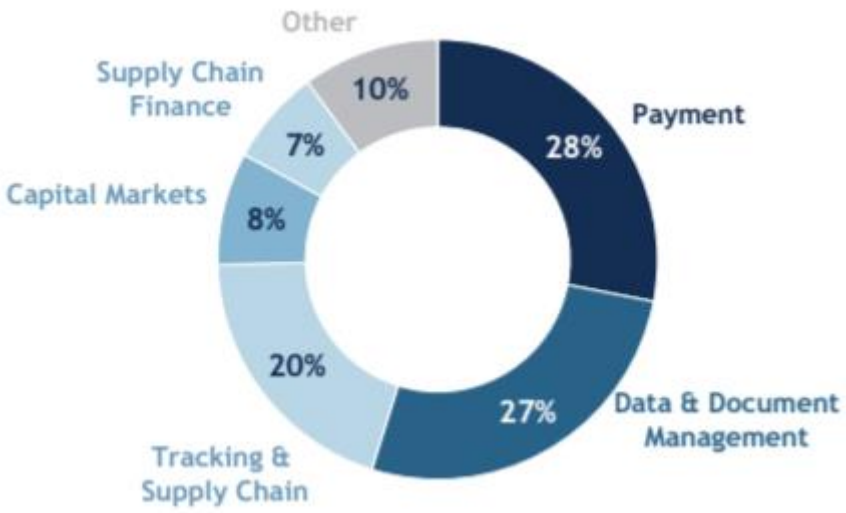
In 2019, considering the 488 total cases, there are 158 applications of which 47 operative projects out of 69 in four years, 43 experiments out of 69 in the same four years and 68 Proof of Concept (PoC) out of 210. These numbers show how in the last year there has been an increase of the awareness of companies in the technology. Regarding the places in which there is more interest, Asia and Europe are the once in which more cases where found with respectively 143 and 128.

In within the different industries that are interested in blockchain, the one that has been more active is the banking industry, followed by the public administration and by the agricultural industry. In the report, the authors made an analysis of the industries the cases were related to. As Figure 7 shows, based on the 158 implementation cases in 2019, the dominant industry in blockchain is the financial one, followed by the government, the agri-food, the logistics and the utility industries.



Source Figure 7: Galasso, D., Micello, E., & Erba, S. (2020). Blockchain & Distributed Ledger: Unlocking the Potential of the Internet of Value. Osservatorio Blockchain & Distributed Ledger, Politecnico di Milano.

Concerning the specific uses that industries are using blockchain for, based on the same 158 cases, payments systems and document management system are the dominant once, followed by chain management. Figure 8 shows what are all the uses with all the different percentages.



Source Figure 8: Galasso, D., Micello, E., & Erba, S. (2020). Blockchain & Distributed Ledger: Unlocking the Potential of the Internet of Value. Osservatorio Blockchain & Distributed Ledger, Politecnico di Milano.

2.3 Real Cases

In this section, real cases of companies implementing blockchain technology will be explored. In particular, the focus will be on the finance, government, agri-food, and logistic industries.

2.3.1 Logistics with Maersk

The case of Maersk is an interesting attempt to use the blockchain technology on the shipping industry. This project was carried on in collaboration with IBM, one of the leading players in the tech industry. The result of the project was the creation of a permissioned blockchain-based platforms for players in the shipping industry.

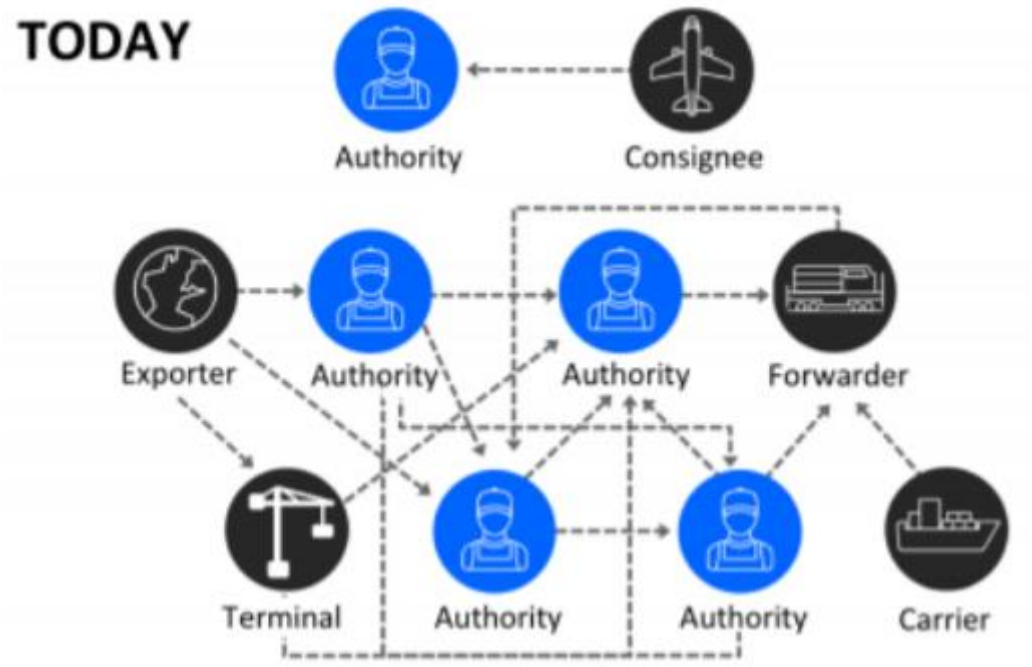
Maersk was born in 1904 in Denmark when A.P. Møller and his dad bought a used steamer. After starting its business, the company increased its fleet. Then in the 1960s' it moved into oil and gas exploration with Maersk Oil. In the next decade Maersk expanded its operations through new businesses such as an airline, IT services and supermarkets, but they were eventually abandoned to focus solely on the logistics and shipping division. In 2017, Maersk oil and Maersk tankers were sold for $8 billion. In the same year, its revenue was of $31 billion and was

operating in around 130 countries. In April 2017, Maersk Line was the biggest container shipping company of the planet with 19% of shares of the industry.

The interest of Maersk in new technologies solutions came from the recognition of how there were many elements that were slowing the shipping process down. Elements such as excessive paperwork, the need of different kinds of authorizations, security issues and more were considerably increasing the time of transportation. In 2014, Maersk and IBM conducted a study to see the effect of paperwork-related processes on the supply chain. The result of this study was that there were many inefficiencies throughout the chain because of how reliable the whole process was on paper, whose cost could go to 20% of the overall cost of physical transportation. Keeping into account all these inefficiencies found on the global supply chain, the team of Maersk and IBM started thinking about solutions that could come in their aid. They eventually though of a blockchain solution, which led to the creation of the IBM solution mentioned before.

In March 2017, the two teaming companies announced that they were planning on creating a global trade digitalization (GTD) for the shipping industry with the help of blockchain. "The solution will help manage and track the paper trail of tens of millions of shipping containers across the world by digitizing the supply chain process from end-to-end to enhance transparency and the highly secure sharing of information among trading partners."[14] And this could help the industry saving billions of dollars. Figure 9 and 10 show how the supply chain would be reorganized through the GTD, enlightening how more organized it would be.

[14] Maersk and IBM Unveil Supply Chain Solution on Blockchain. (2020). Retrieved 7 August 2020, from https://www-03.ibm.com/press/us/en/pressrelease/51712.wss



Source Figures 9 and 10: Lal, R., & Johnson, S. (2018). Maersk: Betting on blockchain.

2.3.2 Banking industry with Nordea

In the banking industry, one of the players that implemented a blockchain solution is Nordea Bank.

Nordea Bank is the result of the merger, in 2001, of four Nordic banks: NordBanken, Unibank, Kreditkassen and Meritabank, and it has now its headquarters in Helsinki, Finland. They operate in 19 countries, including their home markets (Finland, Sweden, Norway and Denmark). In 2019 it can vaunt an operating income of €8.6 billion and total assets of €554.8. Nordea Bank is one of the biggest banks which believes in the support of technology for their business. In fact, in 2004 they became the biggest internet bank measured by payments. Also, in 2015 they launched their first accelerator programme, in which fintech start-ups could apply and, if chosen, could collaborate with Nordea for the creation of technological ideas to support banking activities. Within the 10 selected start-ups, some examples are PayPeanuts, that allows customers to pay using loyalty points online, B2B Pay, which created a banking platform to help international companies, RealSource, a service that "financial data of a property into a smart interactive listing, saving time for both the buyer and the seller."[15] This goal of innovation of Nordea is even more externalized through the creation, in 2016, of the Group digital unit. This has the goal of following the rapidly changing customer behaviour, new financial services and all the new technologies. Lastly, in 2017 it teamed up with the Stockholm Fintech Hub, a hub dedicated to start-ups, financial institutions and regulators. All these efforts brought Nordea to win the 2017 Global Retail Banker "IT Innovation of the Year".

On the same year Nordea joined other 11 banks, such as HSBC and Unicredit, and IBM in the development of a blockchain platform solution called We.Trade. "Almost 60 percent of the SME's…", says Patrik Zekkar[16], Global Head of Trade Finance & Working Capital Management at Nordea, "…said that they have to make advance payments so there is obviously a sense of insecurity surrounding cross-

[15] RealSource.eu — Myy ja osta liikekiinteistöjä vaivattomasti. (2020). Retrieved 8 August 2020, from https://realsource.eu/tour

[16] we.trade - a new easy and secure trade platform. (2020). Retrieved 18 August 2020, from https://www.nordea.com/en/press-and-news/news-and-press-releases/news-group/2018/we-trade-a-new-secure-trade-platform.html

border trade. This is unfortunate, not only from a liquidity standpoint, but it may also lead to companies refraining from trading and not growing". So, by creating a well-connected trading ecosystem this insecurity can be eliminated. This result is achieved by creating a common platform which allows small and medium customers to trade around Europe instantly and in a safe and transparent way. For Nordea, it was firstly launched as a test for small customers in April 2019, to then make it available to all the small and medium size customers.

The We.Trade platform connects companies with customers and suppliers around Europe eliminating the need of trusting the other parts. It also makes all the paperwork related to a trade, making it very easy to keep track of all the active orders. Figure 11 shows all the main features of the We.Trade platform.

Source Figure 11: we.trade common trading platform. (2020). Retrieved 18 August 2020, from https://www.nordea.com/en/our-services/tradefinance/wetrade/

We.Trade can be used in many different ways, so following there are some case studies of the platform retrieved from the We.Trade website[17].

1. A soft drinks manufacturer noticed that up to 71% of invoices were being paid late by its customers, which were using this trick as a source of financing. Consequently, the manufacturer decided to use the autoSettlement We.Trade product, which allowed it to specify the specific

[17] Case Studies. (2020). Retrieved 28 September 2020, from https://www.we-trade.com/resources/case-studies

conditions under which the automatic payment would be triggered by the buyer, guaranteeing the on-time payment.

2. Steelforce, a raw steel manufacturer, had a business opportunity with an existing customer, ASA group, company in the metal packaging sector. The issue came from the fact that internal company policies required a payment security for each sale and the buyer reached their credit limit. The two parts decided to use We.Trade through which the buyer asked for a Bank Payment Undertaking (BPU) towards the seller so that the buyer's bank could now cover any payment risk as requested from the seller.

3. Every week a chemical management service company set in the Netherlands receives goods from its suppliers and at the end of each week it tells them how much goods have been used and then they send the invoice by email and the chemical company has between 30 and 60 days to pay for the consumed goods. It happened that scammers, impersonating the suppliers, sent a fraudulent email asking to send the money to a different IBAN number. This generated big losses for the company because not only they paid the scammers, but they still had to pay the suppliers. With the We.Trade platform all the invoices are sent directly on the platform and every kind of change, as a change of IBAN number, has to be approved before it can happen, mitigating the possibility of scams.

2.3.3 Europe and E-Government

E-government is a broad term which refers to the use of the latest technological solutions to improve government information, services and knowledge. The World Bank defines E-Governments as "government-owned or operated systems of information and communications technologies (ICTs) that transform relations with citizens, the private sector and/or other government agencies so as to promote citizen empowerment, improve service delivery, strengthen accountability, increase transparency, or improve government efficiency"[18]. After around a decade form its introduction, the blockchain technology has been of interest of different

[18] World Bank, LAC PREM – "Issues Note: E-Government and The World Bank". November 5, 2001

governments around the world. A particular interest has been developed by european governments, which have implemented different blockchain solutions for different purposes.

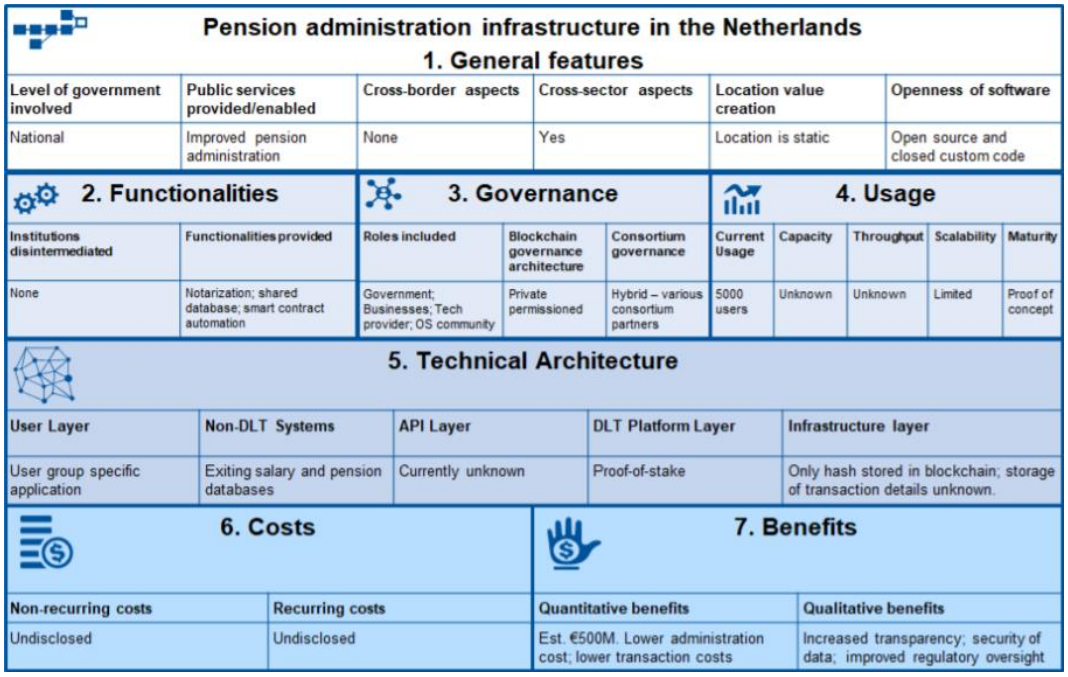
In a study made by the EU Science HUB in 2019[19] it is claimed that the main benefits of using a blockchain technology for governmental purposes are:

- Strong increase of trust of citizens and companies towards governmental processes and recordkeeping because of the se of algorithms that are no longer exclusively controlled by the governments.
- The use of programmable smart contracts and distributed ledgers brings a significant reduction in bureaucracy, corruption and discretionary power.
- Reduction of time, economic cost and complexity in information exchanges within state entities and between state entities and privates improving the administrative functions of the government.
- Higher benefits for citizens due to an increased automation, auditability, accountability and transparency of information in the registries of the government.

In the same study the authors show different cases of how blockchain solutions are used in different counties in Europe. They analyse these cases, part of which will be shown next, dividing each one of them in seven elements: general features, functionalities, governance, usage, technical architecture, costs and benefits.

The first case is about the pension infrastructure used in the Netherlands. It is thought as a community-based infrastructure which aims to higher flexibility and transparency for privates and to inferior management costs. The project, created in 2018 in collaboration between the two biggest pension providers in the country, starts from the recognition of very complex pension schemes for different citizens, such as employees having different job types during their working life, citizens signing up to personal pension schemes and so on. Figure 12 shows the analysis of the case made by the authors.

[19] Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*.



Pension administration infrastructure in the Netherlands

1. General features

Level of government involved	Public services provided/enabled	Cross-border aspects	Cross-sector aspects	Location value creation	Openness of software
National	Improved pension administration	None	Yes	Location is static	Open source and closed custom code

2. Functionalities

Institutions disintermediated	Functionalities provided
None	Notarization; shared database; smart contract automation

3. Governance

Roles included	Blockchain governance architecture	Consortium governance
Government; Businesses; Tech provider; OS community	Private permissioned	Hybrid – various consortium partners

4. Usage

Current Usage	Capacity	Throughput	Scalability	Maturity
5000 users	Unknown	Unknown	Limited	Proof of concept

5. Technical Architecture

User Layer	Non-DLT Systems	API Layer	DLT Platform Layer	Infrastructure layer
User group specific application	Exiting salary and pension databases	Currently unknown	Proof-of-stake	Only hash stored in blockchain; storage of transaction details unknown.

6. Costs

Non-recurring costs	Recurring costs
Undisclosed	Undisclosed

7. Benefits

Quantitative benefits	Qualitative benefits
Est. €500M. Lower administration cost; lower transaction costs	Increased transparency; security of data; improved regulatory oversight

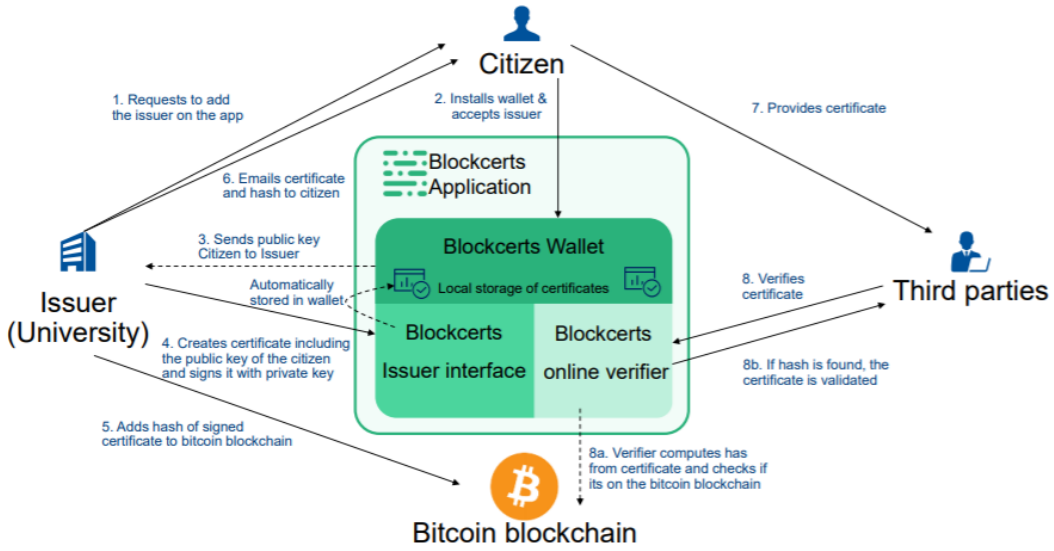
Source Figure 12: Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union.*

The pros of the project are:

1. Decreased transaction costs for the citizens because information is distributed through one single interface.
2. The distributed ledger makes the information safer and more transparent for all the parts involved in the process.
3. Lower pension administration costs. All the data exchanges between government, authorities and pension providers become more automatic with blockchain. The latter estimate €500 million of cost savings.
4. The use of a distributed ledger creates efficiencies in the administration of pensions. These come for the fact that all the parties use the same source of information.

Unfortunately, information regarding the cost of implementation were not disclosed.

Then second case is about a project launched in October of 2017 by the Maltese government. They decided to implement a blockchain solution to verify academic credentials. The ministry of education and employment decided to use a solution based on the Blockcerts open standard. This was created in 2015 by Massachusetts Institute of Technology (MIT) and Learning Machine, a startup specialized in credentialing systems based on the blockchain technology. Figure 13 shows how the Blockcerts system works.



Source Figure 13: Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*.

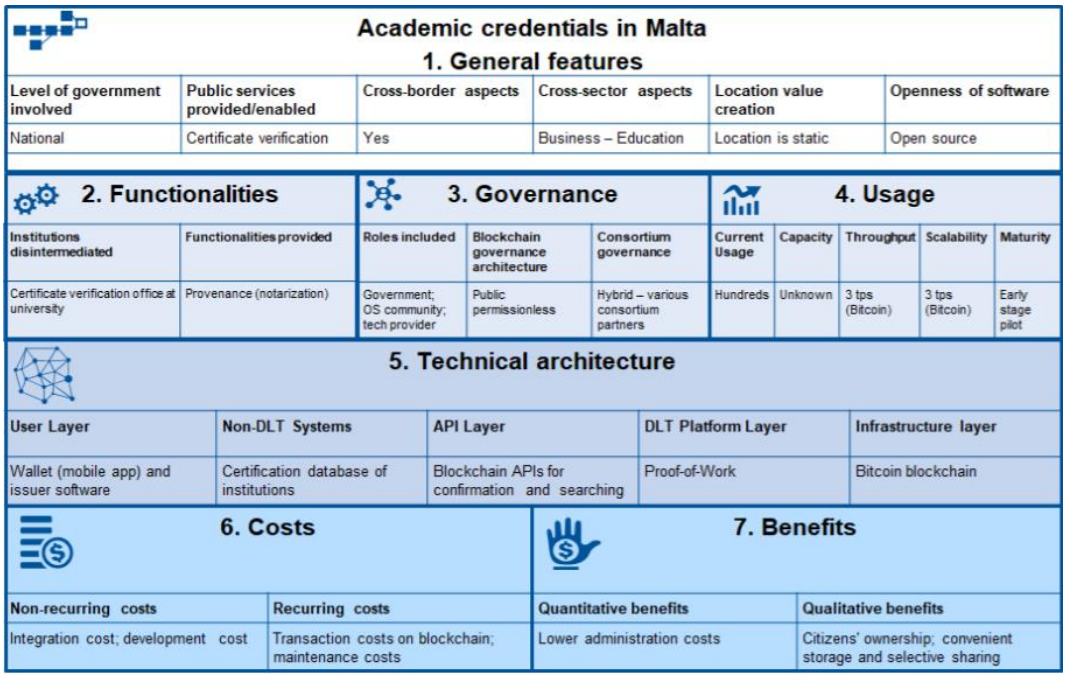
The system works as following:

1. The institution sends a request to the alumni to download the app and to add them as issuers.
2. A citizen installs a wallet and accepts the issuer. Consequently, the wallet will create a private and a public key.
3. After the institution is accepted from the citizen as a provider of certificate, the issuer will receive his/her public key from Blockcerts.
4. Then the issuer generates a digital certificate which includes the public key of the citizen and is signed with the private key of the issuer. After the public

key of the citizen is added, the certificate will be saved on his/her Blockcerts wallet.

5. The issuer creates a hash for the certificate and saves it on the Bitcoin blockchain (it was eventually moved to the Ethereum blockchain)
6. The issuer sends the certificate and the Blockcerts URL which contains the hash to the citizen.
7. The citizen can then send the certificate and the URL to trusted third parties.
8. The third party, which can be another institution, an employer and so on, can check through the Blockcerts online verifier if the hash that was provided with the certificate and the URL corresponds with the one on the Bitcoin blockchain. If there is a correspondence the third party has proof of the validity of the provided certificate.

Figure 14 shows the analysis of the case.



Academic credentials in Malta

1. General features

Level of government involved	Public services provided/enabled	Cross-border aspects	Cross-sector aspects	Location value creation	Openness of software
National	Certificate verification	Yes	Business – Education	Location is static	Open source

2. Functionalities

Institutions disintermediated	Functionalities provided
Certificate verification office at university	Provenance (notarization)

3. Governance

Roles included	Blockchain governance architecture	Consortium governance
Government; OS community; tech provider	Public permissionless	Hybrid – various consortium partners

4. Usage

Current Usage	Capacity	Throughput	Scalability	Maturity
Hundreds	Unknown	3 tps (Bitcoin)	3 tps (Bitcoin)	Early stage pilot

5. Technical architecture

User Layer	Non-DLT Systems	API Layer	DLT Platform Layer	Infrastructure layer
Wallet (mobile app) and issuer software	Certification database of institutions	Blockchain APIs for confirmation and searching	Proof-of-Work	Bitcoin blockchain

6. Costs

Non-recurring costs	Recurring costs
Integration cost; development cost	Transaction costs on blockchain; maintenance costs

7. Benefits

Quantitative benefits	Qualitative benefits
Lower administration costs	Citizens' ownership; convenient storage and selective sharing

Source Figure 14: Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union.*

Now let us analyse the benefits and the costs of the project:

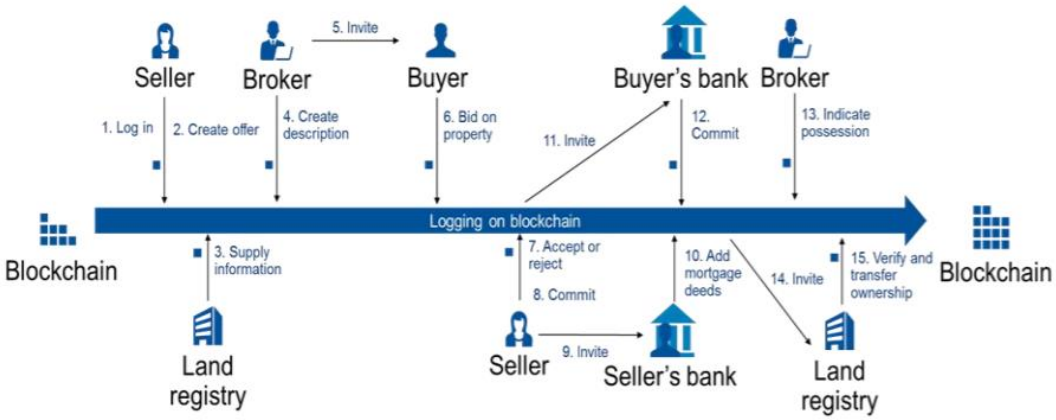
1. An important difference between this system and the traditional one is that the owner of the certificates are no longer institutions, but the citizens themselves. They are the only once that have the permission to share their certificates.
2. For the same reason as before, the system provides a stronger identity and privacy protection.
3. Blockcerts app allows citizens to have all their certifications all in the same wallet, giving higher control over educational achievements and certificates.
4. The new system is more efficient, as all the certificates are kept in the same place and they are easily verifiable and sharable. And this eliminates the need for hard copies.
5. For other institutions or countries, there is the benefit that because the system is built on an open standard, they can build their verifier or credentials issuing systems on the same standard, making them interoperable.
6. The elimination of the need hard copies and transcripts lowers the administration costs for educational institutions.

Regarding the costs of the project, there are two costs that have to be taken into account: the development cost and the implementation and integration cost. The first one is connected to the development of the Blockcerts open standard. The second one, which is the main driver of this project, is connected to the high cost that the system developers have to bear for its creation. Moreover, as stated on the Blockcerts website, the cost of the service depends on the dimensions of the transaction and on the transaction fee. Keeping into account that a Blockcerts transaction is very small and static, the cost mostly depends on the transactions fees. On the 27th of August of 2020, the recommended transaction fee is of 0.00041149 BTC, which is around €3.94

The third and last project that will be presented is set in Sweden and it is implemented in the real estate, a business in which transactions are expensive, slow and exposed to different risks, such as contested property deeds. A blockchain based solution could solve two of the biggest issues, which are the speed of the transactions and the lack of trust between the parties. The project was started in September 2016 by different players: Swedish Mapping, Cadastre and Land Registration Authority, Kairos Future, SBAB, Chromaway, Telia and Landshypotek Bank.

More in details, this solution is made of two components. The first one is a blockchain platform, which is a combination between a centralized database and a private blockchain. While the second one, called Esplix, consists of smart contracts that automatically process all the transactions between the parts.

Figure 15 shows the workflow of a transfer of a real estate with the blockchain solution. As shown in the picture there are five different participants in the process: the real estate agent, the land registry, the buyer, the seller and the banks.



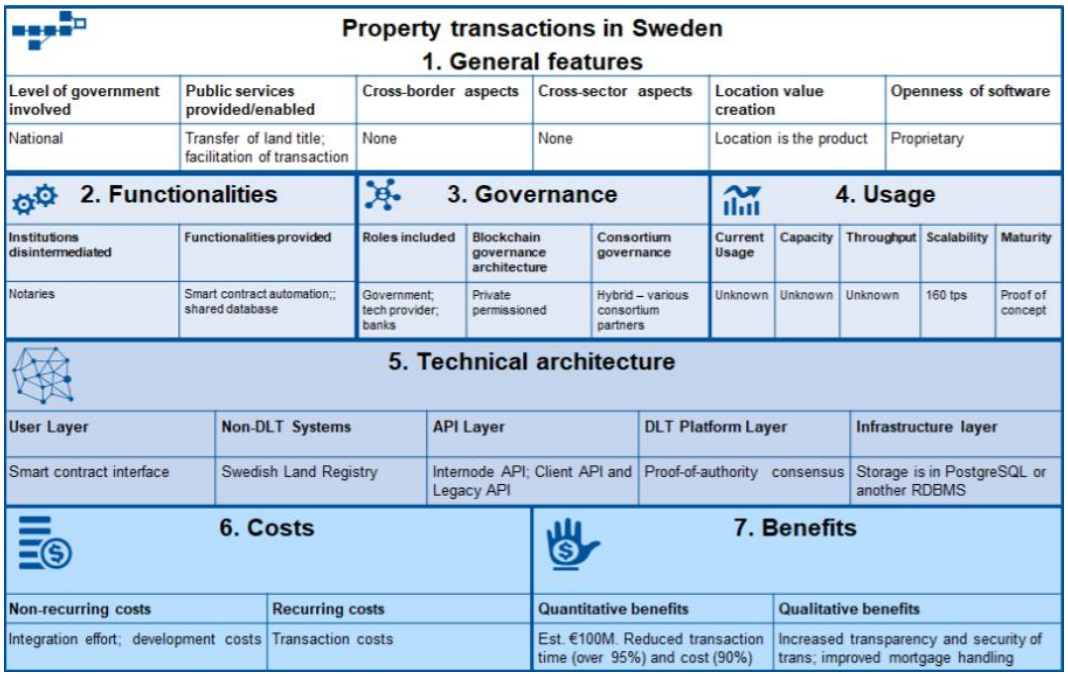
Source Figure 15: Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union.*

The system works a following:

1. The seller logs in the smart contracts mechanism, which can be accessed from the Chromaway website.

2. The seller launches a smart contract and selects the property that he/she wants to sell.
3. The land registry then adds all the information regarding the seller.
4. The real-estate agency makes a review of the property.
5. A buyer is added by the real-estate agent through the buyer's public key.
6. The buyer makes an offer on the property.
7. The seller accepts or rejects the offer. If the offer gets accepted, the buyer is now committed and an agreement is made.
8. The seller adds his/her bank into the flow and this can add the collection of mortgage deeds.
9. After the collection of mortgage deeds is received, the buyer's bank is added into the flow and this commits to transfer the payment for the property.
10. The real-estate agency indicates to the land registry that the transfer of the property happened.
11. The land registry checks that all the steps have been followed properly.

Figure 16 shows what the authors found out about this project.



Property transactions in Sweden

1. General features

Level of government involved	Public services provided/enabled	Cross-border aspects	Cross-sector aspects	Location value creation	Openness of software
National	Transfer of land title; facilitation of transaction	None	None	Location is the product	Proprietary

2. Functionalities

Institutions disintermediated	Functionalities provided
Notaries	Smart contract automation;; shared database

3. Governance

Roles included	Blockchain governance architecture	Consortium governance
Government; tech provider; banks	Private permissioned	Hybrid – various consortium partners

4. Usage

Current Usage	Capacity	Throughput	Scalability	Maturity
Unknown	Unknown	Unknown	160 tps	Proof of concept

5. Technical architecture

User Layer	Non-DLT Systems	API Layer	DLT Platform Layer	Infrastructure layer
Smart contract interface	Swedish Land Registry	Internode API; Client API and Legacy API	Proof-of-authority consensus	Storage is in PostgreSQL or another RDBMS

6. Costs

Non-recurring costs	Recurring costs
Integration effort; development costs	Transaction costs

7. Benefits

Quantitative benefits	Qualitative benefits
Est. €100M. Reduced transaction time (over 95%) and cost (90%)	Increased transparency and security of trans; improved mortgage handling

Source Figure 16: Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*.

Let us now get into benefits and the costs of the project.

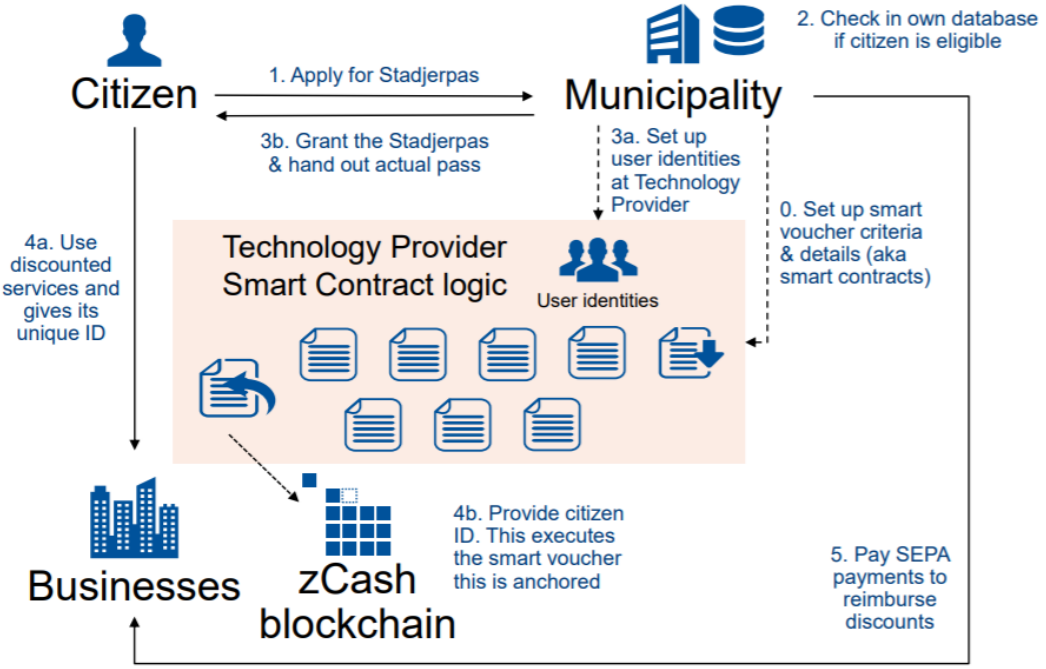
The benefits are the following:

- One of the main effects is that there is more trust between parties, that will consequently start more expensive transfer because there is less probability that one of the parties pulls out. This will also increase the liquidity of the assets.
- The time needed to complete a transfer is considerably reduced from weeks to hours or even minutes, depending on how fast the parties complete each step.
- Being based on a blockchain technology the storage system is more resistant to possible modification attempts.

The costs that have to be taken into account are the integration cost and the operation cost. The first one comes from the fact that in the real estate process there are many parts involved. For example, there is the need to integrate it with the legacy system and with the banking system. The second one is connected to the blockchain protocol, which replicates the consortium database continuously.

The last example comes from the Netherlands, more in the specific from Groningen. It is called Stadjerspas and it consists of a voucher system introduced in 1994 to give discounts to people with lower incomes. These vouchers were paper based until 2013 and then was updated with the blockchain technology in 2016. The main objective of the project is to use smart contracts to better target public money. In this case, smart contracts are used to control the eligibility conditions and the spending conditions. For example, conditions might be the financial income, the limit of usage of discounts and an accurate description of the beneficiaries and the providers. Vouchers can be used in cinemas, sporting centers and to get grants for energy renovation and more.

Figure 17 shows how the system works.



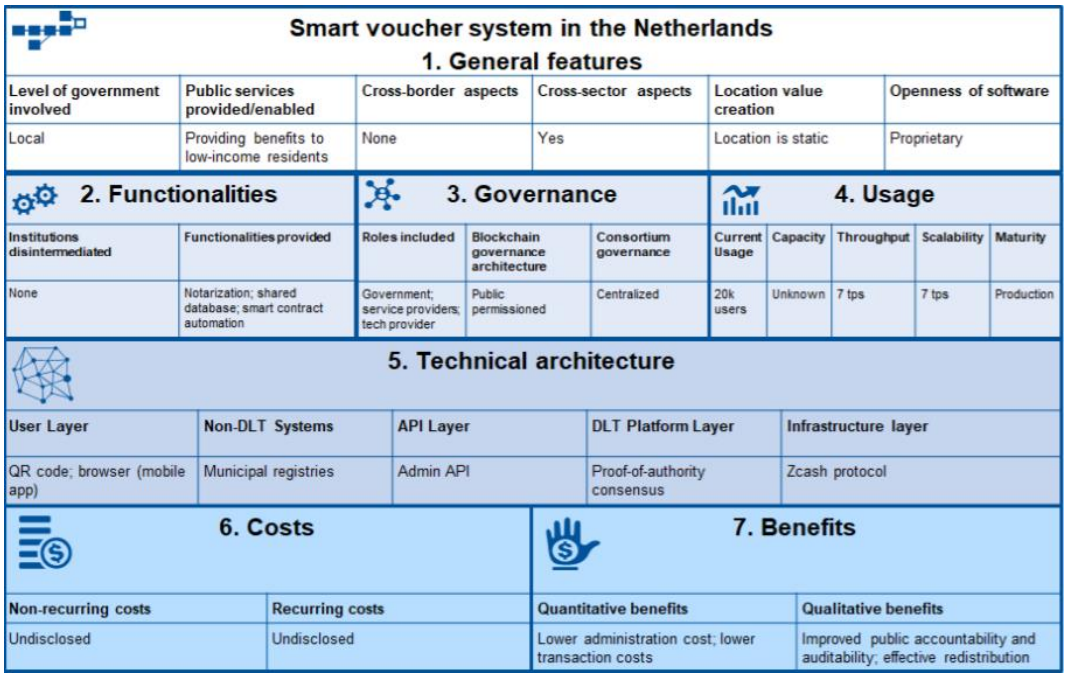
Source Figure 17: Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*.

The system works as following:

1. The citizen applies for Stadjerspas by giving to the Municipality all the information needed.
2. If the citizen is eligible for any voucher, an anonymised user identity is created on the blockchain.

3. With the voucher given to a citizen, he/she receives a QR code connected to his/her identity on the blockchain.
4. The citizen uses the voucher at one of the providers, which before giving the service will scan the QR code so that the smart contracts can check.
5. After the service is provided the municipality sends a SEPA to the provider.

Figure 18 shows the analysis of the authors.



Smart voucher system in the Netherlands

1. General features

Level of government involved	Public services provided/enabled	Cross-border aspects	Cross-sector aspects	Location value creation	Openness of software
Local	Providing benefits to low-income residents	None	Yes	Location is static	Proprietary

2. Functionalities

Institutions disintermediated	Functionalities provided
None	Notarization; shared database; smart contract automation

3. Governance

Roles included	Blockchain governance architecture	Consortium governance
Government; service providers; tech provider	Public permissioned	Centralized

4. Usage

Current Usage	Capacity	Throughput	Scalability	Maturity
20k users	Unknown	7 tps	7 tps	Production

5. Technical architecture

User Layer	Non-DLT Systems	API Layer	DLT Platform Layer	Infrastructure layer
QR code; browser (mobile app)	Municipal registries	Admin API	Proof-of-authority consensus	Zcash protocol

6. Costs

Non-recurring costs	Recurring costs
Undisclosed	Undisclosed

7. Benefits

Quantitative benefits	Qualitative benefits
Lower administration cost; lower transaction costs	Improved public accountability and auditability; effective redistribution

Source Figure 18: Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*.

Finally, let us see the benefits of this system:

- It increases the efficiency of the voucher system. Through the use of smart contracts, the municipality can be sure that the vouchers are used for the purpose they are made for and that who use them are the citizen who asked for them.
- It also increases the operational efficiency. That is because the municipality can check how the vouchers are used and in this way the service can be better programmed and checked. Also, the cost of it is reduced because of the elimination of paper in the process.

The cost of the project has not been disclosed by Groningen municipality.

2.3.4 Food traceability and Walmart

The fourth field of application of blockchain is connected to the agri-food industry. Blockchain-based solutions have characteristics, such as transparency, fault-tolerance, immutability, full traceability, that can solve many issues affecting the industry. More in the specific, traceability has been one of the main issues that have been explored more in depths by start-ups and big players of the food industry.

The interest that this field of application is generating can be observed by the big number of start-ups that work on different steps of the agri-food supply chain. Let us see some example of these:

1. ripe.io: this sturt-up created a platform in which everyone can access information related to the origin, the journey and the quality of food.
2. AgriLedger: this blockchain based platform helps farmers to trace the origins of foods, to easily access to financing and to access a bigger amount of information useful for a better harvest.
3. TE-FOOD: provides a service of identification of transports, fresh food and livestock. As stated on their website their service consists of 5 steps: object identification, data capture, data storage, data processing and data presentation.

Nowadays, the majority of the information related to agriculture and food supply chains are about the orders and the deliveries, without giving any information about where is the food from, where did it passed to reach the final destination, what were the conditions (temperature, care…) products were kept in. The need of new solutions focused on traceability and transparency are a consequence of many food scandals that shook the food industry and pushed consumers, producers and authorities to be more aware of the whole process related to the food supply chain. In history, there are many examples of frauds and of health hazards deriving from bad food supply chain management:

- E-Coli: caused from infected spinach in 2006. It was almost impossible to track down the infected spinach because of the too many players involved in the process.
- Horse burger fraud: in 2013, producers in Europe replaced beef with horse meat inside burgers. The fraud affected more than 4.5 million products.
- Salmonella: caused by infected papayas in 2017. Like the case of the E-Coli, it took around 3 weeks to track down the source of the outbreak.

Table 2 shows the estimates of annual domestically acquired foodborne illnesses attributed to specific food commodities and commodity groups, by pathogen type, in the United States between the 1998–2008

	All agents	Bacterial	Chemical	Parasitic	Viral
Aquatic animals	589,310	142,415	153,488	77,795	215,613
land animals	4,021,839	2,334,000	33,031	156	1,654,651
Plants	4,924,877	1,169,202	62,753	69,023	3,623,899
undetermined	102,275	156	0	86,686	15,433
TOT	9,638,301	3,645,773	249,272	233,660	5,509,596

Source Table 2: Painter, J. A., Hoekstra, R. M., Ayers, T., Tauxe, R. V., Braden, C. R., Angulo, F. J....Griffin, P. M. (2013). Attribution of Foodborne Illnesses, Hospitalizations, and Deaths to Food Commodities by using Outbreak Data, United States, 1998–2008. Emerging Infectious Diseases, 19(3), 407-415. https://dx.doi.org/10.3201/eid1903.111866.

Moreover, food fraud is a very big issue in the food industry. Because of this issue companies are losing money and customers are losing faith. Food fraud is estimated to cost the global food industry US$30 to $40 billion every year.

On this line are the two projects started by the famous American retail corporation, Walmart. These projects were started in collaboration with IBM and have the objective of connect all the players on the agri-food supply chain and to promote a

bigger sharing of information between them. In this way, and with the support of blockchain, traceability and safety are increased.

These two projects were announced in 2016 and consisted in two PoC: the first one was about tracking the mangos that were sold in the US by the Walmart stores while the second one about tracking the pork sold in the stores in China. Regarding the first PoC they started with a benchmark. They bought they bought a package of mangos in the nearest Walmart store and then Walmart Technology team tried to manually track their origin through calls and emails. The result was that the time needed was of seven days. Subsequently the actual blockchain platform was created. It allowed the suppliers to upload, through a web-faced interface, their data. This decreased the tracking time from seven days to just 2.2 seconds. Concerning the second project, the data that could be uploaded on the platform consisted of certificates of authenticity, and this brought a lot of trust in a market that was experiencing the issue of "small-scale "backyard" pork producers"[20], whose products could not be checked quality-wise.

After the big success of the two projects Walmart wanted to expand the system to other products and in collaboration with other players in the industry. This, with the involvement of Nestle and Unilever, brought to IBM food trust. This is a platform created by IBM that connects all the players of the agri-food supply chain and allows both customers and companies to know where the food comes from and the quality of it. It has different characteristics:

- It is open, trusted and flexible: it allows users to easily share data about food, use data from other users and develop new functionalities.
- Is permissioned and immutable
- It consists of a network made of suppliers, growers, distributors and retailers.
- Secure: the system has been awarded for its level of security.

[20] Gale, F. (2017). China's Pork Imports Rise Along with Production Costs. United States Department of Agriculture.

3 - Method and Data collection

In this chapter the author will describe and discuss the methodology that has been followed to answer to one of the research questions. Moreover, the methods used to collect data useful for the study will also be described.

3.1 Research strategy

To find the possible answers to the research question, it is required to precisely plan the research strategy. Consequently, it must have different instruments and methods that are adequate to complete the research. It is important to use methods and instruments which will increase the validity of the data collected for the research.

The research strategy that was chosen consists of the review and gathering of the available studies and research on blockchain. After a deep research of the current literature a problem was spot: in the case of blockchain many of the studies focus more on the consequences that the technology's applications have on a business, but there is a poor research on what are the factors and drivers that have to be taken into account before and during the implementation of a blockchain based solution. After this analysis, the research questions were formulated.

Before starting the discussion about the organizational implications, the author found suitable to have first a broad exploration of the vast topic of the blockchain applications in business. The reason of that is to give to the reader a way to have a deep dive into the situations in which blockchain helps companies in different industries. Understanding in which way and in which context blockchain products are used is a key factor to comprehend even more the logic and the functioning of them so that it will be easier to understand the implications that they have in an organization.

After that, an analysis of the selected literature was made. Aiming for a systematic study of the topic, the factors recognized from the literature were then categorized. These categories were then updated using the information gathered from the interviews that were held with the expert of the field. The final objective of the study is to have an organized and systematic list of issues that are usually related

with blockchain implementation, hoping that this will help companies taking better decisions.

3.2 Research methods

Generally, there are two different kinds of research methods: the qualitative and quantitative method. The first one "describes an event in its natural setting. It is a subjective way to look at life as it is lived and an attempt to explain the studied behaviour."[21] With a qualitative kind of research the researcher tries to describe a contemporary phenomenon and only observes it for the group that is used for the study. On the other hand, a quantitative research has the aim of getting to statistically significant results related to the population. There are two different versions of quantitative research: descriptive and experimental. In the first one the sample is measured in a specific point in time and its demography is described. With the second one the researcher tests the validity of a theory by checking how the independent variables influence the dependent variables.

For the aim of this study and considering the early stages of the theory regarding blockchain implementation in business, the method that was chosen is the qualitative one. The reason behind it is because the organizational implications of a technology implementation, like education of employees, governance of the project, adequate evaluation of the project, are very difficult to quantify. It is more suitable to catch what are the opinions and perceptions of experts of the sector and that have experience in blockchain implementations.

Also the characteristics of the qualitative method fit more for the purpose of the study. Generally, it is more flexible and easily adaptable to real life cases. This allowed to have a more meaningful and detailed insight, capturing the experience of the interviewees.

[21] Lowhorn, G. L. (2007, May). Qualitative and quantitative research: How to choose the best design. In Academic Business World International Conference. Nashville, Tennessee.

3.3 Data collection

To retrieve relevant data for the study, a data collection method needed to be chosen. In the following, it is discussed why semi-structured interviews were chosen.

3.3.1 Choosing a method

A qualitative study can be carried on in different ways: for example, focus groups, case study, participant observation and interviews. Between these, the one that seems more suitable for this study is the interview. That is because it allows to ask open-ended questions to a small group and going in depths on what the individual experiences and opinions regarding the topic.

There are three different types of interviews: structured, unstructured and semi-structured. A structured interview is characterized by the fact that the questions are predetermined and standardised and these are always asked following the same way and order. Unstructured interviews, on the other side, have no structure and it takes the form of oral histories. Lastly, there are the semi-structured interviews, where the questions are predetermined but there is a degree of flexibility in it. As described by Longhurst (2003), "semi-structured interviews and focus groups are similar in that they are conversational and informal in tone. Both allow for an open response in the participants' own words rather than a 'yes or no' type answer." And this degree of flexibility allows to catch a personal thought on the topic. That is the reason why this type of interview is the one chosen for the study.

3.3.2 The interviews

Before the interviews were held, a study on the current literature was made. The information that was retrieved was then used to formulate open-ended questions.

The primary data was collected through the interviews and open-ended questions given to experts of blockchain implementation projects. Considering the instability of the factors influencing a technological implementation, it was more suitable to

get more opinions and practical tips based on experience rather than data objective data collected through a general sample.

The interviews consist of four questions that are given to the interviewed:

1. In which organization do you work and what is your role in it?
2. What are some examples of projects you have worked on and what kind of implementation they consisted of?
3. In your experience, what are the drivers that influence a blockchain implementation?
4. What do you think will be the development of the technology in the future?

These questions had the objective of understanding if the projects and so the experience that they gained from them were relevant for the study, to understand the level of experience of the interviewed and lastly to get insights on their experiences with blockchain-based projects.

For the aim of the thesis, the sample consisted of three experts of the IT sector and more specifically of the blockchain technology. They were approached in different ways. Mostly through personal contacts of the author's network. One of the experts was suggested by another interviewee.

Two of the interviews were conducted in Italian, while the third one in English and they were voice recorded. All the meetings were on google meets because of the geographical position of the interviewees. Each interview took between ten and twenty minutes. After these were taken, the transcript was written down to better catch what were the important elements of the interviews. Due to the difficulty of translating from colloquial Italian to written English the interviews were edited to eliminate all the irrelevant words and sentences.

3.4 Limitations

In this section the limitations of the study will be discussed. In fact this study presents different constraints, both situational and related to the topic. The first comes from the situation the world is living now with the Covid-19 pandemic. It made communicating with the interviewees extremely complicated and this brought to two problems: the sample is definitely too small to give findings that can be

generalized; the length of the interviews could not pass fifteen to twenty minutes so the answers that were given were relatively short. The other set of limitation is related to the topic. Blockchain is still an unexplored topic which lacks previous research studies. This made the selected literature hard to frame in a specific context of relevance. In addition to this, one issue that was found was the limited access of the author to respondents. Consequently, the specific topic of the study had to be slightly changed in order to make it easier to retrieve data.

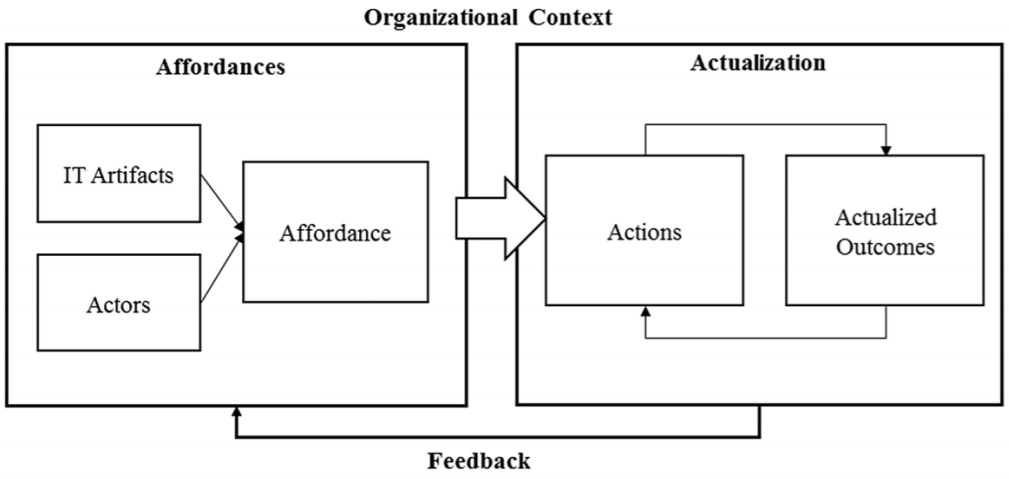
4 - Literature Review

In the following chapter the current literature will be reviewed to extrapolate which are different factors that have to be taken into account when starting a blockchain implementation project.

4.1 The factors influencing a blockchain implementation

The literature regarding blockchain is very limited because of the emergent nature of the technology. Most of the studies that have been made focus more on the potential impacts of new blockchain solutions on different aspects of a business, such as efficient information sharing, integration of the supply chain, reduction of transaction costs, rather than explaining which are the elements that are important for a correct and successful implementation.

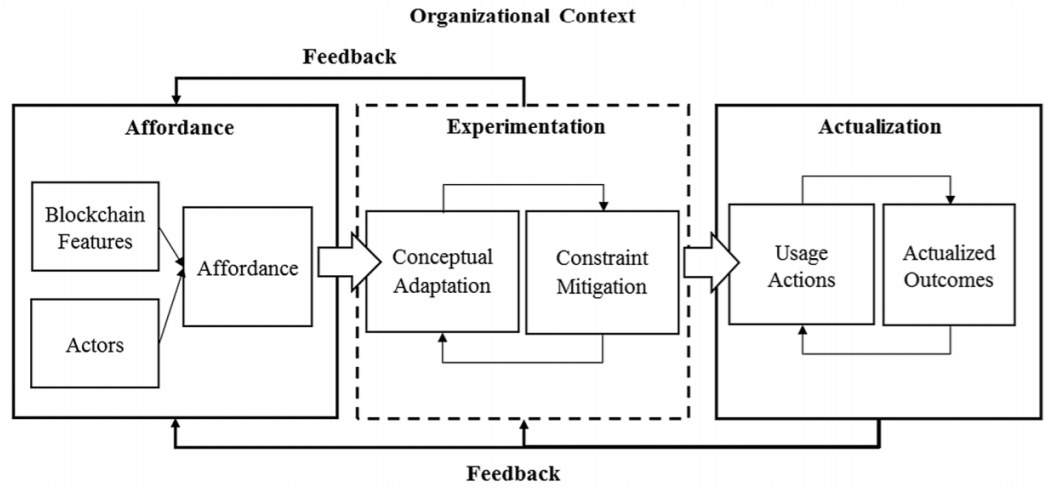
In a paper by Du et al. (2019) the factors that influence a blockchain implementation are studied through a readaptation of the affordance-actualization theory. The concept of affordances is a very important one and it was first introduced by ecological psychologist, J.J Gibson, to describe what is about the environment that contributes to the interaction between an agent and some properties of a system. Then the concept was further developed in different fields of study. The concept of affordance connected to the technological field was first developed by Strong et al. (2014) to explain how to carry out a successful implementation of electronic health records. Affordance-actualization theory is graphically represented by Figure 19.



Source Figure 19: Du, W. D., Pan, S. L., Leidner, D. E., & Ying, W. (2019). Affordances, experimentation and actualization of FinTech: A blockchain implementation study. *The Journal of Strategic Information Systems*, *28*(1), 50-65.

As the name suggests, the theory consists of two phases. The first one is focused on the affordances, in other words the advantages, deriving from the combination of the artifacts of the technology, defined as "clear-cut manifestations of technology"[22], and the actors, considered as all the players involved in the project. The second phase is the actualization of the affordances. It is defined as "the actions taken by actors as they take advantage of one or more affordances through their use of the technology to achieve immediate concrete outcomes in support of organizational goals"[23]. From this framework the authors derived a new one, which is graphically shown by Figure 20.

[22] Verbeek, P. P., & Vermaas, P. E. (2012). Technological artifacts.
[23] Strong, D. M., Volkoff, O., Johnson, S. A., Pelletier, L. R., Tulu, B., Bar-On, I., ... & Garber, L. (2014). A theory of organization-EHR affordance actualization. Journal of the association for information systems, 15(2), 2.



Source Figure 20: Du, W. D., Pan, S. L., Leidner, D. E., & Ying, W. (2019). Affordances, experimentation and actualization of FinTech: A blockchain implementation study. *The Journal of Strategic Information Systems*, *28*(1), 50-65.

The new feature of the new framework is the experimentation phase. It is considered necessary for a successful blockchain implementation because one of the prerequisites of the affordance actualization is that the technology is ready to be implemented and used. So in the case of blockchain, news cases are very specific so an attentive experimentation allows for the development of a news case which is more specific for the company, in the framework this is called conceptual adaptation, and allows for the actors to understand how to use the technology.

The other element of the experimentation phase is the constraints mitigation. In this section there are three constraints that must be taken into account: the first on is related to the employee's education. It was found that one of the issues is that it is hard to explain to the actors how blockchain works without creating confusion. Blockchain is a very complicated technology to understand, so it is important that the explanation focuses more on the question "how can it help the business?" rather than focusing even on the "how does it work?".

The second issue is related to the unknown risk. When starting a blockchain project the organization will be facing against different issues that are mostly unknown. So, it is imperative that an accurate experimentation phase is made. This may be achieved by starting the project with a smaller community or by adding new features gradually.

The third issue mentioned is related to the quantity of data that will be stored on the blockchain. Basically, what it is believed is that it must be thought what kind of and how much data the organization wants to move on the blockchain because this will influence the performance of the solution. Regarding this problem it has to be mentioned that the performance of blockchain solutions are improving every day. Moreover, it was seen in the first chapter that this kind of issues variate from permissioned, permission-less and mixed blockchains. Consequently, the solution might be to always start with an experimentation phase to correct these aspects.

Another important aspect in the framework is the organizational context. Du et al. (2019) believe that there are other three elements related to the organization itself that contribute for a successful implementation and they come from the fact that for the blockchain to have affordances, there must be a network. It is discussed how sometimes it is hard to find cooperation between all the stakeholders of a network.

The first two elements are related to the culture of the organization. The first one is a consequence of the fact that usually blockchain solution providers are start-ups and it is rare that bigger companies cooperate with these. This can be solved with the creation, in within the organization, of a culture that emphasizes the collaboration with start-ups, which have more technical and innovative skills. This emphasis could even be installed in a specific sub-culture at the division level of the company. This finding, say the authors, are consistent with a study from Ravishankar et al. (2011), that found out how in a large knowledge-management system implementation project subcultures have more influence on the success of it rather than organizational culture. The second element is a way of boosting creativity inside the company. Technically is called “Intrapreneurship” and it consists in pushing entrepreneurial thinking in within the organization. This has the result of increasing the speed of growth and development of the organization.

The third and last element is connected to the corporate strategy. It is important to create a strategy based on digitalization. This allows to convince more easily the stakeholders by framing the blockchain project as a part of that corporate strategy. This is backed by Preston and Karahanna (2009), who found that the alignment of a technology with the corporate strategy is a success factor in the implementation.

In 2016, Deloitte made a report on the tech trends of the year. This report gives an idea on what were the technology that were quickly developing at that time. Examples of these were the augmented reality, virtual reality, the internet of things and blockchain. About the last technology, the authors give a detailed list of elements that are important when looking into the blockchain technology. In the following, all these areas of focus will be enlisted, and a short explanation will be given.

1. Understanding the blockchain limitations: usually blockchain is seen as flawless. But as it was seen earlier in this study it is not. There are many issues regarding speed and scalability, and it may require a big amount of energy and time. Moreover, sometimes the big amount of data may represent a problem for the technology.
2. Education: blockchain is different from the other types of technologies because of how confusing it can be to people who have backgrounds that are different from the tech one. It is very important to understand what it is, how it works, and how it can be used in business. Also, as mentioned in the previews study, blockchain news cases are generally very specific, so there is a need for an adaptation to the project's needs.
3. Remember the miners: When using a PoW permission less blockchain solution miners have incentives in the form of cryptocurrencies for carrying out tasks needed for the algorithm. So, it is important to find a way to incentivize miners to mine and add transactions to the chain in the specific news case.
4. Embrace the ecosystem: many players are investing in blockchain. Technology producers, industry institutions, many start-ups, venture capital firms, even big companies not related to technology are investing many of their resources to develop blockchain solutions to help their business. What is important in the early stage of the technology is to understand how to make it easy to adapt to different needs coming from different industries rather than finding a standard version for all the situations.

5. Know your trust zones: there are many different choices when it comes to blockchain: permissioned, permission-less, hybrid, plus different solutions in the same type. The pros and cons that come with a specific kind are different and they are very noticeable. Bigger players are creating permissioned platforms where users are known and trusted. In every different case there are different "trust zones", so they have to be known.
6. Partnerships: a blockchain project requires big investments and research, so it might be a good idea to team up with other players to speed up its development. But it is important to understand if that is a good idea, if the offer of the other part will really bring positive results to the organization. Moreover, is equally important to study the other part by checking the board, the funding level, the leadership team and the financial viability. Even the dimension of the partner is important, because from that it will depend how balanced the future negotiations will be. Finally, considering that blockchain needs a network to function, it can be thought even of teaming up with competitors.
7. Regulation and compliance: regarding the regulation there are two considerations. The first one is that the speed at which the technology is developing is way higher than the one at which the regulation is moving. This allows users to get some benefits in the short term. Clearly, regulation will then catch up. While this is true for the permission-less ledgers this is not for the permissioned, which are regulated through private agreements and inspected by the authorities. The other consideration is related to the important role that usually third parties, clearing houses and other central authorities have in arbitration and conflict resolution, even if very costly and inefficient, and their power of reversing transactions. There is a very strong technological difference between blockchain and the older financial systems. Even if there is such big difference, it can be beneficial for the whole legal and financial system to develop a standardized regulation for open ledger.

In a study from Lacity, M. C. (2018), from the university of Arkansas, it is observed "how enterprises are building blockchain-based business applications and

overcoming the challenges to deliver real business value."[24] This was done by investigating how companies were doing every step of the implementation: from the first business visions to the release of the final product. The method of study consisted in interviews to managers asking them about how they were carrying out the implementing process, how they were participating in the blockchain ecosystem and what they learned during the process; moreover, the author used surveys given to the participants of the Outsourcing World Summit of 2017 and of 2018 always asking them about their experience on a blockchain implementation process; lastly, the author participated in the Center for Supply Chain Studies' project to understand what were the blockchain standards regarding the tracing of pharmaceuticals in the U.S.

The findings of Lacity, M. C. (2018) are that there are five important issues that must be considered before starting a blockchain implementation project.

First, understanding if a blockchain solution really can solve the organization's need. There are many different architectures of distributed ledgers were the data gets stored in different locations and the consensus is reached through computer algorithms, and blockchain represents a special kind of these. The big difference with the traditional distributed ledgers is that the latter are controlled by one organization that manages the data to its liking. To find a possible solution to this issue, the authors give two situations in which a blockchain might be a more suitable solution:

1. The first one is when safety is preferred over performance. When the organization needs a safe distributed ledger blockchain is more suitable than traditional once because generally they have proved to be safer. On the other hand, performance is reduced. As mentioned in chapter 1 of this paper Bitcoin can only process 7 transactions per second, while Visa can process 24.000 transactions per second[25]. Usually an organization has this situation when: there is a lack of trust between the parties, when multiple parts are needed to complete a transaction, when the data on the database needs to

[24] Lacity, M. C. (2018). Addressing key challenges to making enterprise blockchain applications a reality. *MIS Quarterly Executive*, *17*(3), 201-222.

[25] go to chapter 1

remain unchanged and when processes need a sharing of information between the parties.
2. The second one is when the parties do not want to rely on a third party. Usually this is needed when a stronger connection between the parties is sought.

Second, there is a problem related to regulation. This represents one of the big unknows that come when implementing a blockchain product. This is often a very controverse topic because from one side businesses want to educate regulators, but on the other side they do not want regulators to get so close. Moreover, regulators are not aligned on the matter. Some are against, other are supportive and others did not give any opinion. From the study two possible solutions are found:

1. The first possible solution is to create a lobby with many big players with the objective of changing the regulation in their favour.
2. The other one consists in deeply understanding the existing regulation and create a blockchain solution that is in line with it.

Third, understanding how to create a working ecosystem in order to maximise the success of blockchain. Here there are three different ways:

1. Enticement strategy: in this strategy the organization attracts participants using free content. For example, in the case seen in the study, the company uses a free catalogue for general properties of its product.
2. Grassroots strategy: this strategy consists in finding other participants locally
3. Mimetic strategy: with this strategy participants are added by making them follow the industry leaders, which will promote the blockchain solution.

Four, it is important to decide standards to agree upon. The users have to decide what kind of data they want to store on the blockchain: the messages, information, the rights and formats. There are three strategies to approach this issue:

1. First, the organization can use already used standards. This can be done when the kind of use of the blockchain product is pretty standardize so other organizations' standards can be used to access their know-how.

2. Second, the organization can create its own standards. This is usually suitable when it has very particular needs.
3. Third, the organization can join a blockchain consortium. There are many different consortia. Examples of these are R3 or the Ethereum enterprise alliance. The author specifies how in many of the cases studied for the paper, organizations were first joining many consortia to then narrow down their participation.

Lastly, a clear governance is needed. There are many elements that must be decided before starting the project. Three types of governance where identify:

1. Regulatory governance: in this model, the governance is given to a regulatory body, bringing the benefit of regulatory compliance. On the other hand, this is a more centralized model.
2. Democratic shared governance: every participant of the network has equal votes in the deliberations.
3. Representative governance: in this model, who decides is voted by the participants of the network.

4.2 Categorization

To clear up all the findings and for the objective of this study, all the elements that have been discussed in this chapter will be grouped in four different categories that the author thinks can well summarize them. Later in the next chapter the same categories will be modified with additional elements that have been found through interviews.

Considering all the factors that are given in the three studies it seems like they can be grouped in four categories: education, experimentation, organization, regulation. In the following these categories will be summarized.

- Education: it seems like it is very important to educate people in within the organization and all the other external players involved in the project. First the project team needs to understand what is the real need and if a blockchain based product can really solve it. Second, it is imperative that all

the people involved, from employees to the other companies that would be involved, need to be carefully educated on the potentials of the technology. It is also very important to understand in which situations a blockchain solution might be suitable compared to other technologies.

- Experimentation: after understanding what blockchain can do, it is important to carry out an experimentation project. This can be in size or in time. Start a project on a small portion of the organization or for a limited period of time. This modus operandi will show what are all the general limitations of the technology and which are the once related to the specific use case and what is the best way to carry out the final project. Consequently, it can be evaluated if blockchain is what is really needed, or if the need can be solved through a different technology.
- Organization: it is imperative to understand the environment the company is in: what are the stakeholders, if they are willing to cooperate with start-ups, if they are willing to start a partnership and if this will be profitable for the partners. It is also needed to modify and adjust the organization's internal culture, the organizational culture or one of the many subcultures, in order to show to the others that a blockchain implementation is in line with the strategy. Also, is important to create an ecosystem made of different players interacting with each other and trusting each other. Lastly, the governance of the network must be cleared in advance in order to avoid disagreement between the participants. Choosing the right form of governance might change the result of the project.
- Regulation: it is also very important to understand what the regulation about blockchain is. The latter is a technology in an early stage of its cycle and regulation is still not clear on whether to support it or be against it. Decisions about if the specific product will or will not accommodate the regulation might be fundamental for the project.

5 – Data analysis

In the following chapter the author will report what were the findings that could be extrapolate from the interviews that were held with the technology experts. After discussing about them, they will be used to update the categories that were explained in the previous chapter.

5.1 Findings

To create order in the reporting of the findings the following structure will be followed: first the projects that the interviewees worked on will be reported to understand the kind of experience that they had with blockchain, after that the factors will be enlisted and explained.

5.1.1 Interview 1

The first interviewee works for PricewaterhouseCoopers (PwC) in the blockchain lab. Him and his office have worked particularly with four technologies: Bitcoin, Ethereum, ConsenSys and Corda. The first two were already explained in this study. Regarding the second two, ConsenSys is the leader in the Ethereum blockchain software engineering and they currently have a close business relationship with PwC; Corda is blockchain platform that was launched in 2016 by R3. Now, PWC is the only company in Italy which can issue Corda developer certificates.

Two projects examples were given from the first interviewee:

- The first one was made in collaboration with one of the major Italian banking groups and consisted on developing an application that allows to time stamp on the blockchain every access and authorization that is given when accessing to sensitive systems with a two-factors authentication. Currently, this system is being used by around fifty thousand users, a big number for a blockchain system.
- The second example of blockchain implementations on which PwC is working on is the digital identity, also called self-sovereign identity. They think that this is one of the blockchain implementation that has a lot of potential for the future.

Following the list of factors that in the interviewee's experience influence the implementation:

- Using blockchain where it really brings some benefits. This can be analysed by doing a feasibility study for example. It is really important to understand what aspects of the organization, of the service or product will be affected by the implementation, and if the benefits that are usually brought by it will are really what the organization is looking for. It is important to have an inductive approach: first observe what the problem is and then evaluate all the difference technological possibilities that can solve it.
- Because blockchain systems are decentralized, the governance both of the project and of the infrastructure must be clear. What are the roles and how they will be carried out. For example, who will manage the system, who will validate transactions and so on. It must be completely decided in all its parts before the project starts.
- It is not needed to replicate the infrastructure every time that a project is carried out. It is very important to understand which already existing infrastructure the solution would be based on. The best achievement would be to have an open global network where many different projects will be distributed
- Education and training are very important. Not only in between an organization but even with the public. For example, there is the general idea that Bitcoin is a currency that is used for criminal purposes and this might influence the implementation of bitcoin projects.
- The organization needs to understand what kind of structure it has and its size. If the organization has a very strict structure it might be hard to implement a blockchain solution because of how radical the change would be.
- Paying attention to the kind of service that the company offers: in the case of supply chain the solutions used lose the sense of blockchain. In a permissioned blockchain you cannot really trust all the parts involved so the trust component is lost.

5.1.2 Interview 2

The second interviewee is the director of the Blockchain lab in Deloitte Ireland. The office serves mostly the EMEA regions, Europe, Middle East and Africa, but they work globally. They help all kinds of customers during the implementation process, from the first business ideas to the actual implementation of the blockchain product.

The projects on which he worked on were different. Following some of them will be reported:

- The first project was in collaboration with DNVLG. This is a Norwegian business assurance company that operates all over Europe. Their main business is the release of ISO certificates, these "certification can be a useful tool to add credibility, by demonstrating that your product or service meets the expectations of your customers. For some industries, certification is a legal or contractual requirement."[26] The objective of this project was to bring all the ISO certificates business on a public blockchain, with the aim of stop their falsification and to stop delays in their renewal.
- The second one is always in collaboration with DNVLG and it is called "bring your own certificate" (BYOC). It allows all the partners or customers of DNVLG to release their certifications and attestations on the public blockchain through an Application Programming Interface (API). These are programming tools that the major software houses and industries in the IT world, such as Microsoft, Google and Facebook, make available to developers to facilitate their task in creating applications of various kinds. In this case they are the interface that others can access the blockchain, which could not be accessible without it.
- In 2018, they were the first once globally to conduct a proof of solvency on an ICO.
- This project was one of the most important and is in collaboration with B3i, a reinsurance consortium. It is an application called b3i Reinsurance, built on a platform called B3i Fluidity platform. The interviewee work on the

[26] Certification. (2020). Retrieved 19 September 2020, from https://www.iso.org/certification.html

setup of the business case and to the delivery of the product. It works on the Corda blockchain. It is a support for the electronic placement and administration of Property Catastrophe Excess of Loss (Cat XoL) treaties. This product is used to calculate a specific risk, and this gets uploaded on the public blockchain so that everyone can see it and decide if investing in it.

- The last project was made in collaboration with the Institute of Bankers (IoB). This institute do courses and releases certifications to become financial advisors. The issue is that it is very hard to keep track of the situation of every bank employee and to deliver all the information to the regulator, the Irish Central Bank. So, they decided to create digital identities of the employees collecting in one spot all these data on the public blockchain so that becomes easier to keep track of them.

Following there is the list of factors that for the second interviewee must be taken into account:

- A blockchain technology aims at disintermediating and bring trust where there is not. Therefore, it is imperative the presence of an ecosystem. A blockchain based product allows the creation of a network of a very big number of members.
- Not only there has to be an ecosystem, but this needs to be understood. Understanding what kind of ecosystem, it is needed to implement a suitable blockchain solution: what kind of users there are, what is the relationship between them and the organization, are they willing to cooperate and so on.
- The governance of the system is important: how do we manage the network? who writes smart contracts? Who defines the initial definition of digital asset? It must be understood that there is a difference between the governance of the whole network and the governance of the maintenance of the application.
- Understanding what kind of structure the company has. Blockchain radically changes how the organization of a company works, so it is easier for smaller companies, which are more flexible and elastic, to successfully

implement a blockchain product. Bigger companies might have different issues that might slow down or ruin the implementation process: for example, for a big company in the financial industry might take up to a year to make the blockchain application pass all the security checks.

5.1.3 Interview 3

The third interviewee works in a FinTech consulting company called Interwoven Ltd. This company offers advisory and interlocutory services to FinTech firms. It has its offices in Dublin, Ireland.

In this case the example of project he worked on was given through a document and not explained in the interview. This project was a collaboration between the Irish Fund and Deloitte and is called "Project Lighthouse". The aim of the project was to assess the ability of blockchain to service regulatory reporting requirements. The assessment was on an application that was supporting fund administrators to store and analyse fund data and to execute and validate regulatory reporting requirements through smart contracts. In addition, the safety of data transmission between regulator and firms and the overall increase of reporting efficiency and market transparency was tested.

Following the list of factors given by the third interviewee:

- There is usually a risk of risk and compliance: the blockchain technology is relatively new and it is not clearly proven, so most of the time there must be an intensive work on convincing people in within the organization of the validity of a blockchain solution.
- Regarding the network connected with the blockchain application, it is very important to set ground rules for the responsibilities: who is responsible for technical problems, who will get sued if problems arise.
- Understanding if the participants of the network are willing to cooperate. This really depends on the size and structure of the companies involved and on the specific industry.
- Educating the employees is important: the tasks that employees have to fulfil are the same, but they are presented in a different way.

- It is imperative to set standard operating procedures: these "is a set of step-by-step instructions compiled by an organization to help workers carry out complex routine operations."[27]

5.2 Updated Categorization

In the following section the categories presented and explained in section 4.2 will be reported here and they will be enriched with the findings from the interviews hoping to create a clear and detailed frame of the drivers of a blockchain implementation.

- Education: it seems like it is very important to educate people in within the organization and all the other external players involved in the project. First the project team needs to understand what is the real need and if a blockchain based product can really solve it. Second, it is imperative that all the people involved, from employees to the other companies of the network, need to be carefully educated on the potentials of the technology. An important addition to the previous statement is that in some situations it might be needed to educate also the public around the organization because there might be some false beliefs that might ruin the success of the project (for ex. The belief of the cryptocurrency as the currency of criminals). It is also very important to understand in which situations a blockchain solution might be suitable compared to other technologies. For this instance, an inductive approach is suggested: the organization should start from the needs and the benefits sought and then explore all the possible technological solutions. Also, a feasibility study might come in use to answer to some key questions such as where and in which situations blockchain brings real benefits to an organization? What are the organizational elements that will be influenced by it? Lastly, a broad exploration of the existing blockchain infrastructures is suggested. One of the revolutionary features of blockchain is that allows to create different applications on the same infrastructures as

[27] Standard operating procedure. (2020). Retrieved 19 September 2020, from https://en.wikipedia.org/wiki/Standard_operating_procedure#:~:text=A%20standard%20operating%20procedure%20(SOP,to%20comply%20with%20industry%20regulations.

Corda or Ethereum, consequently it is not needed to create a new one for every project.

- Experimentation: after understanding what blockchain can do, it is important to carry out an experimentation project. This can be in size or in time. Start a project on a small portion of the organization or for a limited period of time. This modus operandi will show what are all the general limitations of the technology and which are the once related to the specific use case and what is the best way to carry out the final project. Consequently, it can be evaluated if blockchain is what is really needed, or if the need can be solved through a different technology. Through the experimentation phase, standard operating procedures must be tried and then approved. There is no better way to understand successful procedures that with practice.
- Organization: it is imperative to understand the environment the company is in: what are the stakeholders, if they are willing to cooperate with start-ups or in general with other companies, if they are willing to start a partnership and if this will be profitable for the partners. It is also needed to modify and adjust the organization's internal culture, the organizational culture or one of the many subcultures, in order to show to the others that a blockchain implementation is in line with the strategy. Also, is important to create an ecosystem made of different players interacting with each other and trusting each other. Moreover, the governance came up to be one of the central drivers of a blockchain implementation. From the literature it was highlighted how important it is to have a clear governance of the network, meaning the roles, the responsibilities and mainly the decision-making process of all the participants of the network. But from the interviews, another kind of governance was suggested: the governance of the system. This refers to the management of the blockchain itself. Who writes the codes, who has which rights and powers on the blockchain, who is responsible for its maintenance? These are also key factors in a blockchain implementation. Lastly, the size and age of the organization itself has a major influence on a technology implementation. Especially in the case of blockchain, which radically changes the functioning of the organization,

flexibility and elasticity are fundamental for a successful implementation. The interviewee often expressed how they saw projects failing because of the rigidity of the structure of the organization interested. Also, the kind of product or service offered by the company influences its rigidity/flexibility.

- Regulation: it is very important to understand what the regulation about blockchain is. This technology is in an early stage of its cycle and regulation is still not clear on whether to support it or be against it. Depending on the geographical location it might radically change. Decisions about if the specific product will or will not accommodate the regulation might be fundamental for the project. Another important aspect that came out of the interviews is that the regulation changes depending on the size and the kind of product or service offered by the company. In some industries regulation might be more stringent and in others more accommodating. Lastly, the interviewees showed how important it is also to understand the responsibilities in within the network. It might not be clear how the regulation protects or punishes members of a blockchain network.

5.3 The Future of Blockchain

In this last section the author will do a brief discussion about the future of blockchain in business. In the interviews the interviewees were asked about their opinion about this topic. As mentioned multiple times, this technology is at an early stage, so it is hard to give sure predictions about its future. Anyways, based on what we have today some approximative predictions can be formulated.

One of the main players in the blockchain game is IBM and its blockchain team predicted five trends in the future:

- Other technologies will combine with blockchain to create more trustworthy data that will allow to improve the underlying algorithms. This will also allow for an improvement of the data driven decision-making process of the participants of the network.
- New governance models will arise in the next future and they will allow for standardization of data from different sources. Also, an interesting feature

that is expected is a scalable governance that will allow interactions between multiple blockchain networks

- Central banks will start using Central Bank Digital Currencies (CBDC). This kind of currency and its usage will grow with time and will change the rules of payments. In addition, the tokenization and digitalization of digital assets will expand.
- Even if will take a long time for this, it is believed that an industry-wide blockchain network will be created.
- Validation tools will make the blockchain data more secure and safe. This tools basically link digital assets to the physical world by inserting outside data into the networks.

The last question of the interview was given to have a brief idea of what the interviewees opinion about the future of the technology will be. Following their answers will be reported.

The general idea that they gave was that for sure the big interest that has been experienced in the last years will slow down. And out of all the uses that are out today many of them will eventually disappear, but there will be a strong development of those use cases that are useful. One example that was given is the one about supply chain. In this instance blockchain really changed how it works. With it every information about what is been transported can be stored and seen by all the players that have interest in the process, from the food distributors to the regulators and governments.

The other big use case that will gain relevance is the one of the digital identities. Soon there will not be the need of certifications, documents and other identifications or attestations. Every information about a person will be stored in one place. Surely, the safety measures will have to be improved but this will surely happen. Especially, after the Covid-19 crisis this use case will help understanding if a person has the certification of negativity and this might help with the elimination of the virus.

The last big use case that will grow in the future is the one of the cryptocurrencies. As it was predicted by the IBM blockchain team, there will be a switch from the

regular currencies to the cryptocurrencies. This will surely change the way payments work. It will take a long time for this to happen.

The last consideration is that in the future, with the help of other technologies, the potential of blockchain will intensify. Surely, the public will get more and more in touch with the technology.

Conclusion

As said different times during this study, blockchain is indeed a revolutionary technology. It has the power of disrupting many industries and their functioning. Since its introduction to the world, it changed a lot, and its use cases grew exponentially. It went from be the underlying system of a cryptocurrency to tracking where the chicken of your supermarket comes from and what are the steps it made to arrive at its destination. Its importance is shown by the interest that many companies and not only have on the technology. In a report by Deloitte[28] they found that there is a very strong flux of investments in blockchain. The authors surveyed a sample of 1.386 senior executives in different countries. They found out that "53 percent of respondent say that blockchain technology has become a critical priority for their organizations in 2019."

After broadly exploring the different applications that have been implemented in many different companies and after listening to the interviewees' projects it is interesting to see how not only it already has a big number of different applications but also how many are still not discovered or developed. Every application seen in this study has one thing in common: it helps where there is an important flux of data. This said, it might be used in every application that consists in the gathering and the analysis of enormous quantity of data. At the current state, it does not have the power of doing that, but in the future it surely will.

As explained by Tom Golway, Chief technologist at Hewlett Packard Enterprise, "As a foundational innovation, blockchain's value can be fully realized

[28] Insights, D. (2019). Deloitte's 2019 Global Blockchain Survey. *Blockchain Gets Down to Business. Deloitte*.

when the business process is transformed to take advantage of its capabilities, leading to an increased ROI for existing business models and the ability to create value through new business models. Without transforming the business process, blockchain only offers the potential of incremental value in reducing total cost of ownership."[29] It is fundamental to understand what are the changes needed and in which situations blockchain best gives benefits to the organizations. And this was the main objective of this study: studying what are the conditions that are needed to fully exploit this powerful technology. This study might be the starting point for a further and more complete study of these conditions, hoping that organization will have a clearer method to have successful blockchain implementations.

[29] How to accelerate time to value for blockchain initiatives. (2020). Retrieved 21 September 2020, from https://www.hpe.com/us/en/insights/articles/how-to-accelerate-time-to-value-for-blockchain-initiatives-1807.html

Bibliography

Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*.

Beck, R., & Müller-Bloch, C. (2017, January). Blockchain as radical innovation: a framework for engaging with distributed ledgers as incumbent organization. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.

Beck, R., Stenum Czepluch, J., Lollike, N., & Malone, S. (2016). Blockchain–the gateway to trust-free cryptographic transactions.

Briggs, B., Foutty, J., & Hodgetts, C. (2016). Tech trends 2016: Innovating in the digital era. In *Blockchain: Democratized trust Distributed ledgers and the future of value*. Deloitte University Press.

Caro, M. P., Ali, M. S., Vecchio, M., & Giaffreda, R. (2018, May). Blockchain-based traceability in Agri-Food supply chain management: A practical implementation. In *2018 IoT Vertical and Topical Summit on Agriculture-Tuscany (IOT Tuscany)* (pp. 1-4). IEEE.

Chen, Y. (2018). Blockchain tokens and the potential democratization of entrepreneurship and innovation. *Business Horizons*, *61*(4), 567-575.

Chohan, U. W. (2017). A history of bitcoin. *Available at SSRN 3047875*.

Cong, L. W., & He, Z. (2019). Blockchain disruption and smart contracts. *The Review of Financial Studies*, *32*(5), 1754-1797.

Du, W. D., Pan, S. L., Leidner, D. E., & Ying, W. (2019). Affordances, experimentation and actualization of FinTech: A blockchain implementation study. *The Journal of Strategic Information Systems*, *28*(1), 50-65.

Dunn, K. (2005) 'Interviewing', in I. Hay (ed.) Qualitative Research Methods in Human Geography (2nd edn). *Melbourne: Oxford University Press*, pp. 79–105

Galasso, D., Micello, E., & Erba, S. (2020). Blockchain & Distributed Ledger: Unlocking the Potential Of the Internet Of Value. Osservatorio Blockchain & Distributed Ledger, Politecnico di Milano.

Gale, F. (2017). *China's Pork Imports Rise Along with Production Costs*. United States Department of Agriculture.

Greeno, J. G. (1994). Gibson's affordances.

Hileman, G., & Rauchs, M. (2017). Global blockchain benchmarking study. *Cambridge Centre for Alternative Finance, University of Cambridge, 122*.

Houben, R., & Snyers, A. (2018). Cryptocurrencies and blockchain. *Bruxelles: European Parliament*.

Hyperledger. (2019). How Walmart brought unprecedented transparency to the food supply chain with Hyperledger fabric.

Insights, D. (2019). Deloitte's 2019 Global Blockchain Survey. *Blockchain Gets Down to Business. Deloitte.*

Kamath, R. (2018). Food traceability on blockchain: Walmart's pork and mango pilots with IBM. *The Journal of the British Blockchain Association, 1*(1), 3712.

Kokina, J., Mancha, R., & Pachamanova, D. (2017). Blockchain: Emergent industry adoption and implications for accounting. *Journal of Emerging Technologies in Accounting, 14(2), 91-100.*

Lacity, M. C. (2018). Addressing key challenges to making enterprise blockchain applications a reality. *MIS Quarterly Executive*, *17*(3), 201-222.

Laurent, P., Chollet, T., Burke, M., & Seers, T. (2018). The tokenization of assets is disrupting the financial industry. Are you ready. *Inside. Triannual insights from Deloitte*, (19), 62-67.

Liu, M., Wu, K., & Xu, J. J. (2019). How Will Blockchain Technology Impact Auditing and Accounting: Permissionless versus Permissioned Blockchain. Current Issues in Auditing, 13(2), A19-A29.

Longhurst, R. (2003). Semi-structured interviews and focus groups. *Key methods in geography*, *3*(2), 143-156.

Lowhorn, G. L. (2007, May). Qualitative and quantitative research: How to choose the best design. In *Academic Business World International Conference. Nashville, Tennessee*.

Massias, H., Avila, X. S., & Quisquater, J. J. (1999). Design of a secure timestamping service with minimal trust requirement. In *the 20th Symposium on Information Theory in the Benelux*.

Moogk, D. R. (2012). Minimum viable product and the importance of experimentation in technology startups. *Technology Innovation Management Review*, *2*(3).

Nakamoto, S. (2019). *Bitcoin: A peer-to-peer electronic cash system*. Manubot.

Natarajan, H., Krause, S. K., & Gradstein, H. L. (2019). Distributed Ledger Technology (DLT) and blockchain. FinTech note; no. 1. Washington, DC: World Bank Group.

Painter, J. A., Hoekstra, R. M., Ayers, T., Tauxe, R. V., Braden, C. R., Angulo, F. J., & Griffin, P. M. (2013). Attribution of foodborne illnesses, hospitalizations, and deaths to food commodities by using outbreak data, United States, 1998–2008. *Emerging infectious diseases*, *19*(3), 407.

Panzardi, R., Calcopietro, C., & Ivanovic, E. F. (2002). New-economy sector study electronic government and governance: lessons for Argentina. *New-economy sector study: electronic government and governance-lessons from Argentina Retrieved from http://documents. worldbank. org/curated/en/527061468769894044/pdf/266390WP0E1Gov1gentina1Final1 Report. pdf*.

Preston, D. S., & Karahanna, E. (2009). Antecedents of IS strategic alignment: a nomological network. *Information systems research*, *20*(2), 159-179.

PwC, P. (2016). Food fraud vulnerability assessment. Free online tool helps food companies fight fraud to protect consumers.

Ravishankar, M. N., Pan, S. L., & Leidner, D. E. (2011). Examining the strategic alignment and implementation success of a KMS: A subculture-based multilevel analysis. *Information Systems Research*, *22*(1), 39-59.

Strong, D. M., Volkoff, O., Johnson, S. A., Pelletier, L. R., Tulu, B., Bar-On, I., ... & Garber, L. (2014). A theory of organization-EHR affordance actualization. *Journal of the association for information systems*, *15*(2), 2.

Swan, M. (2015). Blockchain: Blueprint for a new economy. " O'Reilly Media, Inc.".

Szabo, N. (1996). Smart contracts: building blocks for digital markets. *EXTROPY: The Journal of Transhumanist Thought, (16)*, *18*(2).

Terzi, S., Votis, K., Tzovaras, D., Stamelos, I., & Cooper, K. (2019). Blockchain 3.0 Smart Contracts in E-Government 3.0 Applications. *arXiv preprint arXiv:1910.06092*.

Verbeek, P. P., & Vermaas, P. E. (2012). Technological artifacts.

Wang, S., Ouyang, L., Yuan, Y., Ni, X., Han, X., & Wang, F. Y. (2019). Blockchain-enabled smart contracts: architecture, applications, and future trends. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, *49*(11), 2266-2277.

Witzig, P., & Salomon, V. (2018). *Cutting out the middleman: a case study of blockchain-induced reconfigurations in the Swiss Financial Services Industry*. Université de Neuchâtel.

Sitography

-->, <., & -->, <. (2020). Bitcoin 101: Pros and Cons of Proof of Stake Mining — Steemit. Retrieved 18 August 2020, from https://steemit.com/cryptocurrency/@heiditravels/bitcoin-101-pros-and-cons-of-proof-of-stake-mining

A beginner’s guide to Ethereum. (2017). Retrieved 27 July 2020, from https://blog.coinbase.com/a-beginners-guide-to-ethereum-46dd486ceecf

AgriLedger - Agriledger. (2020). Retrieved 1 September 2020, from http://www.agriledger.io/

Bitcoin price index monthly 2012-2020 | Statista. (2020). Retrieved 28 July 2020, from https://www.statista.com/statistics/326707/bitcoin-price-index/

Bitcoin's Price History. (2020). Retrieved 28 July 2020, from https://www.investopedia.com/articles/forex/121815/bitcoins-price-history.asp

Blockchain Credentials. (2020). Retrieved 27 August 2020, from https://www.blockcerts.org/

Blockchain Technology Solutions | Ethereum Solutions | ConsenSys. (2020). Retrieved 4 September 2020, from https://consensys.net/

Case Studies. (2020). Retrieved 28 September 2020, from https://www.we-trade.com/resources/case-studies

Certification. (2020). Retrieved 19 September 2020, from https://www.iso.org/certification.html

Cos'è Ethereum? | ethereum.org. (2020). Retrieved 27 July 2020, from https://ethereum.org/it/what-is-ethereum/

Denial Of Service Attack (DoS) Definition. (2020). Retrieved 26 July 2020, from https://www.investopedia.com/terms/d/denial-service-attack-dos.asp

Do, W., Are, W., People, O., Us, J., Us, C., & Notice, P. et al. (2020). What We Do - B3i. Retrieved 19 September 2020, from https://b3i.tech/what-we-do.html

Griffith, K. (2014). A Quick History of Cryptocurrencies BBTC — Before Bitcoin. Retrieved 24 July 2020, from https://bitcoinmagazine.com/articles/quick-history-cryptocurrencies-bbtc-bitcoin-1397682630

History of PayPal: Timeline and Facts. (2020). Retrieved 26 July 2020, from https://www.thestreet.com/technology/history-of-paypal-15062744

History of R3 Blockchain Platform & Corda Enterprise | R3. (2020). Retrieved 4 September 2020, from https://www.r3.com/history/

How does blockchain work?. (2019). Retrieved 24 July 2020, from https://learnmeabitcoin.com/technical/blockchain

Informazioni su Ethereum | ethereum.org. (2020). Retrieved 27 July 2020, from https://ethereum.org/it/learn/#proof-of-work-and-mining

Introduction — hyperledger-fabricdocs master documentation. (2020). Retrieved 27 July 2020, from https://fabricdocs1.readthedocs.io/en/issue-fab-7895/blockchain.html

Krogdahl, P. (2019). Nordea's journey with Blockchain and We.Trade - IBM:n Think-blogi. Retrieved 19 August 2020, from https://www.ibm.com/blogs/think/fi-fi/2019/05/28/nordeas-journey-with-blockchain-and-we-trade/

Lee-Zogbessou, J., Lee-Zogbessou, J., & Lee-Zogbessou, J. (2018). Five food scandals that rocked the foodservice industry. Retrieved 31 August 2020, from https://www.verdictfoodservice.com/insight/food-scandals-foodservice-industry/

Pierre, E. (2017). Enterprise Ethereum Alliance Launches - Enterprise Ethereum Alliance. Retrieved 4 September 2020, from https://entethalliance.org/enterprise-ethereum-alliance-launches/#:~:text=The%20founding%20members%20of%20the,Morgan%2C%20Microsoft%2C%20and%20Nuco.

Proof of Work vs Proof of Stake Comparison - DevTeam.Space. (2018). Retrieved 18 August 2020, from https://www.devteam.space/blog/proof-of-work-vs-proof-of-stake-comparison/

ripe.io. (2020). Retrieved 31 August 2020, from https://www.ripe.io/

Schlapkohl, K., & Schlapkohl, K. (2020). The future of blockchain - Blockchain Pulse: IBM Blockchain Blog. Retrieved 21 September 2020, from https://www.ibm.com/blogs/blockchain/2020/04/the-future-of-blockchain/

Standard operating procedure. (2020). Retrieved 19 September 2020, from https://en.wikipedia.org/wiki/Standard_operating_procedure#:~:text=A%20sta

ndard%20operating%20procedure%20(SOP,to%20comply%20with%20industry%20regulations.

Start-up accelerator programme to be launched. (2020). Retrieved 8 August 2020, from https://www.nordea.com/en/press-and-news/news-and-press-releases/news-en/2015/2015-10-26%20Start-up%20accelator%20programme%20to%20be%20launched.html

The Various types of Crypto Tokens. (2018). Retrieved 16 September 2020, from https://medium.com/@medipedia/the-various-types-of-crypto-tokens-26bab8f6622c

Understanding Public vs. Private Blockchain - SelfKey. (2020). Retrieved 29 July 2020, from https://selfkey.org/understanding-public-vs-private-blockchain/

we trade – Nordea co-developed blockchain platform has performed its first trades. (2020). Retrieved 19 August 2020, from https://www.nordea.com/en/press-and-news/news-and-press-releases/news-group/2018/2018-07-03-we-trade-nordea-co-developed-blockchain-platform-has-performed-its-first-trades.html

we.trade - a new easy and secure trade platform. (2020). Retrieved 18 August 2020, from https://www.nordea.com/en/press-and-news/news-and-press-releases/news-group/2018/we-trade-a-new-secure-trade-platform.html

Were There Cryptocurrencies Before Bitcoin?. (2020). Retrieved 24 July 2020, from https://www.investopedia.com/tech/were-there-cryptocurrencies-bitcoin/#:~:text=Hashcash,currencies%2C%20according%20to%20The%20Merkle.

What are Consortium Blockchains, and What Purpose do They Serve? | OpenLedger Insights. (2020). Retrieved 29 July 2020, from https://openledger.info/insights/consortium-blockchains/#:~:text=The%20consortium%20blockchain%20is%20a,company%20and%20cross%2Ddiscipline%20solutions.

What Are Smart Contracts? [Ultimate Beginner's Guide to Smart Contracts]. (2020). Retrieved 27 July 2020, from https://blockgeeks.com/guides/smart-contracts/

What is Consensus Algorithm In Blockchain & Different Types Of Consensus Models. (2018). Retrieved 29 July 2020, from https://medium.com/@BangBitTech/what-is-consensus-algorithm-in-blockchain-different-types-of-consensus-models-12cce443fc77

What Is Ethereum? | Ethereum For Beginners | Start Here!. (2020). Retrieved 27 July 2020, from https://education.district0x.io/general-topics/understanding-ethereum/what-is-ethereum/

Executive summary

Introduction

This study will concern the organizational side of the blockchain technology. It will try to make the reader aware of what are all the implications connected to an implementation and what are those conditions and factors on which the success or fail of projects depend on. The author believes that in order to understand what these implications are is imperative to clearly discern the underlying logic and the reason why it was invented; it is also fundamental to clarify how it is currently used in companies to identify what are the possible benefits deriving from it and what are those situations in which a blockchain project can be successful.

The structure of the study will reflect this belief and will drive the reader through the process that brought the blockchain products in the business world and at the end will give a clear and straightforward understanding of its organizational implications. The structure is the following:

1. The blockchain: in the first chapter a detailed and broad explanation of the history and the functioning of blockchain will be given. It starts with the discussion about its origins in 2008 and starts a schematic explanation of the technology by its key elements. After, the functioning will be explained as explained by its inventor, Satoshi Nakamoto. The last part is focused on the support of smart contracts with Ethereum and on permissioned and permissionless blockchains.
2. Blockchain 3.0 and its applications: the second chapter will explain the process that brought distributed ledger technology in the business world, usually referred as Blockchain 3.0. It has many applications in different industries. This chapter aims to explore what are the main industries that are investing in blockchain and explain how they are using it. In particular, the focus will be on the financial, agri-food, governments and logistic industries and for each of them an example will be explained in detail.

3. From this section the focus will switch to the study on the organizational implications of blockchain. here the method and the data collection technique will be explained.
4. In the fourth chapter the literature regarding the conditions and factors involved in a blockchain project will be reviewed. In particular, three studies will be used. In order to make the findings clearer and more straightforward, in the end they will be grouped in four categories.
5. In the last chapter the findings from the literature will be enriched through data collected with interviews. The interviewees are experts of the FinTech industry, with a focus on blockchain. After that, there will be a brief digression on the future of the system trying to answer at the following questions: which applications will survive? Which once will be abandoned? What are the trends that will be seen in the following years? At the end the four categories from the previous chapter will be then updated using the data from the interviews. This will make the findings of this study more complete and broader.

This said, the study will answer to the following research questions:

1. What are the industries that invested the most in blockchain and what are its most important business applications?
2. What are the issues and factors that have to be taken into account before and during a blockchain implementation project?
3. What might be the future of the blockchain technology in business?

1 – Blockchain

The blockchain technology was introduced in 2008 by Satoshi Nakamoto with a paper called “Bitcoin: A Peer-to-Peer Electronic Cash System”, about “an electronic payment system based on cryptographic proof instead of trust, allowing

any two willing parties to transact directly with each other without the need for a trusted third party."[30]

It is a digital ledger characterized by several important principles that make it such a unique technology:

- It is decentralized: there is no central authority and all the users are connected with each other.
- Based on peer-to-peer transmissions: the transactions between users are direct.
- It is irreversible: the ledger cannot be modified.

An important element constituting the blockchain structure is the consensus algorithm. There are many different types but the main two are the Proof-of-Work (PoW) and the Proof-of-Stake (PoS). Both involve the users of the network completing a task. In the PoW protocol this task consist in solving a mathematical problem in exchange of a prize in cryptocurrencies. When the task is completed, a hash is put on the block and it is added to the chain. In the second case, the task is simply the one of checking the information in the block. The user that have to complete this task is decided with an algorithm that chooses one based on the stakes they set.

The best way to explain the functioning of blockchain is through the example of Bitcoin. It was launched right after the paper published in 2008 through a platform for Bitcoin transactions and the issue of the first Bitcoins. This technology is the first one to solve two issues that affected every other attempt of digital cash: the double-spend problem and the Byzantine generals' computing problem. The first problem is connected to the absence of a central authority in the process. In fact, not having a trusted part in the process brings the issue that an owner of a coin could spend said coin twice (or more times) without the others knowing it. The second problem is related to the fact that in order to have the process working, a coordination communication mechanism between parts that do not trust each other is needed. The process through which these issues are solved starts from the transactions. Every coin can be considered as a succession of signatures of all its

[30] Nakamoto, S. (2019). Bitcoin: A peer-to-peer electronic cash system. Manubot.

owners, allowing users to check if a coin was already spent. The second problem is solved through timestamping. This technique allows to record the time in which a transaction occurred, eliminating the need of trust between the users. The third step is the PoW protocol which was explained previously.

With the development of the blockchain technology another interesting concept could be implemented: smart contracts. In a famous example made by its inventor, Nick Szabo, smart contracts can be compared to a vending machine, which through an automatic mechanism gives back the selected product and the change, given the price on the screen. With the same principle contracts give back an automatic action after the user "drops" a bitcoin in the "vending machine", and this can have many different applications. Technically, they can be defined as those computer protocols that help with the verification and enforcement of contracts between different users of a blockchain. The first blockchain that supports smart contracts is Ethereum. The peculiarity of the blockchain based platform is that it can be used to create decentralized applications, called dApps, using smart contracts.

There are two different kinds of blockchains. The first one is permissionless, or public, and are characterized by the fact that to become a user in the network no preapproval of a third-party is needed, so they can just join at will. All that is needed is a computer and an installed software that supports the blockchain. Opposed to that there is the permissioned, or private, kind of blockchain. In this case the users are selected by the owner or administrator of the blockchain. This last kind of blockchain was born to meet companies' needs of security and privacy. There is also another kind of blockchain which is a hybrid between the previous two in which the owner of the blockchain is a group of people or organizations called "consortium".

One last element worth mentioning is the tokenization. A token is a digital representation of any asset and these can be created by anyone by using the Ethereum blockchain and they can be used to interact with different decentralized applications. An interesting consideration is that entrepreneurs started using tokens for funding their business. This is called initial coin offering (ICO). Through an ICO the entrepreneur sells its company's tokens to the global investors.

2 - Blockchain 3.0 and its applications

This chapter will be focused on most of the applications of blockchain technology in business and which industries are investing more on it. This kind of application of the technology is referred as blockchain 3.0, to distinct it from the previous applications. Conventionally blockchain has been distinguished in three different versions, to diversify the different applications that it has had during its history. Blockchain 1.0 is referred to its first application, which is the support of financial payment automation with no central authorities. Then, with the creation of Ethereum, blockchain 2.0 started. It differs from the first version because of the support of smart contracts and the creation of decentralized applications. Lastly, there is blockchain 3.0, which is different from the other two versions because it goes beyond finance actions and asset transfer and has many applications in industries such as healthcare, governments, education, banking, insurance, real estate and charities.

According to a report[31] made by Politecnico di Milano in 2020 on Blockchain, in 2019, considering the 488 total cases of blockchain applications and announcements registered, there are 158 applications of which 47 operative projects out of 69 in four years, 43 experiments out of 69 in the same four years and 68 Proof of Concept (PoC) out of 210. Always related to these cases the authors analysed which industries were more active. It came out that the first one is finance, followed by governments, agri-food, logistics.

Following the author will show examples of blockchain applications in the industries mentioned before.

Logistics: Maersk, the biggest container shipping company, worked on a project in collaboration with IBM, one of the leading players in the tech industry, with the aim of creating a permissioned blockchain-based platform for the whole shipping industry. Through this platform the shipping companies could eliminate all the inefficiencies related to the paper-based work and save billions of dollars.

[31] Galasso, D., Micello, E., & Erba, S. (2020). Blockchain & Distributed Ledger: Unlocking the Potential of the Internet of Value. Osservatorio Blockchain & Distributed Ledger, Politecnico di Milano.

Finance: In 2017, Nordea, one of the biggest banks in the northern countries of Europe, joined other 11 banks, such as HSBC and Unicredit, and IBM in the development of a blockchain platform solution called We.Trade. The platform connects companies with customers and suppliers around Europe eliminating the need of trusting the other parts. It also makes all the paperwork related to a trade, making it very easy to keep track of all the active orders.

Government: countries around the world got very interested in blockchain solutions that could help making some activities more efficient. In a study made by the EU Science HUB in 2019[32] the authors found that the different benefits of using a blockchain technology for governmental purposes: increased trust towards governments; significant reduction in bureaucracy, corruption and discretionary power; reduction of time, economic cost and complexity in information exchanges within state entities and between state entities and privates; higher benefits for citizens due to an increased automation, auditability, accountability and transparency of information.

Agri-food: Blockchain-based solutions have characteristics, such as transparency, fault-tolerance, immutability, full traceability, that can solve many issues affecting the industry. More in the specific, traceability has been one of the main issues that have been explored more in depths by start-ups and big players of the food industry. Improved traceability can solve two huge issues: food fraud and food quality. On this line, Walmart and IBM carried out a project aiming at connecting all the players on the agri-food supply chain and to promote a bigger sharing of information between them. The result of this project was the creation of IBM food trust: a platform that connects all the players of the agri-food supply chain and allows both customers and companies to know where the food comes from and the quality of it.

3 - Method and Data collection

The research strategy that was chosen consists of the review and gathering of the available studies and research on blockchain. After a deep research of the current

[32] Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*.

literature a problem was spot: in the case of blockchain many of the studies focus more on the consequences that the technology's applications have on a business, but there is a poor research on what are the factors and drivers that have to be taken into account before and during the implementation of a blockchain based solution. After this analysis, the research questions were formulated.

Before starting the discussion about the organizational implications, the author found suitable to have first a broad exploration of the vast topic of the blockchain applications in business. The reason of that is to give to the reader a way to have a deep dive into the situations in which blockchain helps companies in different industries. Understanding in which way and in which context blockchain products are used is a key factor to comprehend even more the logic and the functioning of them so that it will be easier to understand the implications that they have in an organization.

After that, an analysis of the literature was made. Aiming for a systematic study of the topic, the factors recognized from the literature were then categorized. These categories were then updated using the information gathered from the interviews that were held with the expert of the field. The final objective of the study is to have an organized and systematic list of issues that are usually related with blockchain implementation, hoping that this will help companies taking better decisions.

For the aim of this study and considering the early stages of the theory regarding blockchain implementation in business, the method that was chosen is the qualitative one. The reason behind it is because the drivers that usually influence a technological implementation, like education of employees, governance of the project, adequate evaluation of the project, are very difficult to quantify. It is more suitable to catch what are the opinions and perceptions of experts of the sector and that have experience in blockchain implementations.

For the collection of data the method that was chosen is the semi-structured interviews. The reason behind it is because they have a degree of flexibility that allows to catch personal thoughts of the interviewee on the topic and in this instance this is very important to understand what are the most critical elements in a blockchain implementation.

4 - Literature Review

In this chapter, three studies are reviewed to capture the most important elements that influence a blockchain implementation. These will be then categorized to sum up the findings.

In a paper by Du et al. (2019) the factors that influence a blockchain implementation are studied through a readaptation of the affordance-actualization theory. The concept of affordance connected to the technological field was first developed by Strong et al. (2014) to explain how to carry out a successful implementation of electronic health records. As the name suggests, the theory consists of two phases: affordances and actualization. The first one concerns the understanding of the technology, the way this interacts with the actors and how this interaction brings benefits. The second one concerns the actions that the actors have to take to exploit the affordances. The authors revisited the theory by adding a third phase in the middle which is the experimentation phase.

The findings of this paper are the following:

- Experimentation: is a necessary phase because it prepares the technology to be fully implemented
- Constraints mitigation: generally there are three constraints. The first one is related to the employees' education; the second one concerns the unknown risk the organization runs into when starting a blockchain project; the last one is connected to the performance of the blockchain: the more data is loaded on the chain the more the chain's performance decreases.
- Organizational context: again there are three elements that have to be taken into account. The first one is that usually blockchain solution providers are start-ups and big companies rarely collaborate with these. The second one is about the level of "intrapreneurship": how much is the entrepreneurial thinking incentivised in within the company; the third one is the corporate strategy: creating a strategy based on digitalization will convince the stakeholders of the project more easily.

The second study used is a report by Deloitte about the tech trends in 2016. In this the author recognizes seven areas of focus that are important when implementing a blockchain product:

- Understanding the blockchain limitations: There are many issues regarding speed and scalability, and it may require a big amount of energy and time.
- Education: blockchain can be confusing to people who have backgrounds that are different from the tech one.
- Remember the miners: it is important to find a way to incentivize miners to mine and add transactions to the chain in the specific news case.
- Embrace the ecosystem: is important in the early stage of the technology to understand how to make it easy to adapt to different needs coming from different industries rather than finding a standard version for all the situations.
- Know your trust zones: there are many different choices when it comes to blockchain: permissioned, permission-less, hybrid, plus different solutions in the same type. In every different case there are different "trust zones", so they have to be known.
- Partnerships: it might be a good idea to team up with other players to speed up its development. It can be thought even of teaming up with competitors.
- Regulation and compliance: regarding the regulation there are two considerations. The first one is that the speed at which the technology is developing is way higher than the one at which the regulation is moving. This allows users to get some benefits in the short term. Clearly, regulation will then catch up. The other consideration is related to the fact that there is a very strong technological difference between blockchain and the older financial systems. Even if there is such big difference, it can be beneficial for the whole legal and financial system to develop a standardized regulation for open ledger.

In the third paper by Lacity, M. C. (2018) it is observed "how enterprises are building blockchain-based business applications and overcoming the challenges to

deliver real business value."[33] The method consisted of surveys and interviews to managers asking them about how they were carrying out the implementing process, how they were participating in the blockchain ecosystem and what they learned during the process. The findings of Lacity, M. C. (2018) are that there are five important issues that must be considered before starting a blockchain implementation project:

- Need: understanding if a blockchain solution really can solve the organization's need.
- Regulation: regulators are not aligned on the matter. Some are against, other are supportive and others did not give any opinion.
- Ecosystem: understanding how to create a working ecosystem in order to maximise the success of blockchain.
- Standards: it is important to decide standards to agree upon.
- Governance: there are many elements that must be decided before starting the project.

To clear up all the findings and for the objective of this study, all the elements that have been discussed in this chapter will be grouped in four different categories that the author thinks can well summarize them.

Considering all the factors that are given in the three studies it seems like they can be grouped in four categories: education, experimentation, organization, regulation. In the following these categories will be summarized.

- Education: it seems like it is very important to educate people in within the organization and all the other external players involved in the project. First the project team needs to understand what is the real need and if a blockchain based product can really solve it. Second, it is imperative that all the people involved, from employees to the other companies that would be involved, need to be carefully educated on the potentials of the technology.

[33] Lacity, M. C. (2018). Addressing key challenges to making enterprise blockchain applications a reality. *MIS Quarterly Executive*, *17*(3), 201-222.

It is also very important to understand in which situations a blockchain solution might be suitable compared to other technologies.

- Experimentation: after understanding what blockchain can do, it is important to carry out an experimentation project. This can be in size or in time. Start a project on a small portion of the organization or for a limited period of time. This modus operandi will show what are all the general limitations of the technology and which are the once related to the specific use case and what is the best way to carry out the final project. Consequently, it can be evaluated if blockchain is what is really needed, or if the need can be solved through a different technology.

- Organization: it is imperative to understand the environment the company is in: what are the stakeholders, if they are willing to cooperate with start-ups, if they are willing to start a partnership and if this will be profitable for the partners. It is also needed to modify and adjust the organization's internal culture, the organizational culture or one of the many subcultures, in order to show to the others that a blockchain implementation is in line with the strategy. Also, is important to create an ecosystem made of different players interacting with each other and trusting each other. Lastly, the governance of the network must be cleared in advance in order to avoid disagreement between the participants. Choosing the right form of governance might change the result of the project.

- Regulation: it is also very important to understand what the regulation about blockchain is. The latter is a technology in an early stage of its cycle and regulation is still not clear on whether to support it or be against it. Decisions about if the specific product will or will not accommodate the regulation might be fundamental for the project.

5 – Data analysis

In the following chapter the author will the data retrieved from the interviews will be used to update the categories that were explained in the previous chapter. After, a discussion about the future of the technology will be made.

After collecting the data from the interviews, the categories presented and explained in the previous chapter will be updated hoping to create a clear and detailed frame of the drivers of a blockchain implementation.

- Education: it seems like it is very important to educate people in within the organization and all the other external players involved in the project. First the project team needs to understand what is the real need and if a blockchain based product can really solve it. Second, it is imperative that all the people involved, from employees to the other companies of the network, need to be carefully educated on the potentials of the technology. An important addition to the previous statement is that in some situations it might be needed to educate also the public around the organization because there might be some false beliefs that might ruin the success of the project (for ex. The belief of the cryptocurrency as the currency of criminals). It is also very important to understand in which situations a blockchain solution might be suitable compared to other technologies. For this instance, an inductive approach is suggested: the organization should start from the needs and the benefits sought and then explore all the possible technological solutions. Also, a feasibility study might come in use to answer to some key questions such as where and in which situations blockchain brings real benefits to an organization? What are the organizational elements that will be influenced by it? Lastly, a broad exploration of the existing blockchain infrastructures is suggested. One of the revolutionary features of blockchain is that allows to create different applications on the same infrastructures as Corda or Ethereum, consequently it is not needed to create a new one for every project.

- Experimentation: after understanding what blockchain can do, it is important to carry out an experimentation project. This can be in size or in

time. Start a project on a small portion of the organization or for a limited period of time. This modus operandi will show what are all the general limitations of the technology and which are the once related to the specific use case and what is the best way to carry out the final project. Consequently, it can be evaluated if blockchain is what is really needed, or if the need can be solved through a different technology. Through the experimentation phase, standard operating procedures must be tried and then approved. There is no better way to understand successful procedures that with practice.

- Organization: it is imperative to understand the environment the company is in: what are the stakeholders, if they are willing to cooperate with start-ups or in general with other companies, if they are willing to start a partnership and if this will be profitable for the partners. It is also needed to modify and adjust the organization's internal culture, the organizational culture or one of the many subcultures, in order to show to the others that a blockchain implementation is in line with the strategy. Also, is important to create an ecosystem made of different players interacting with each other and trusting each other. Moreover, the governance came up to be one of the central drivers of a blockchain implementation. From the literature it was highlighted how important it is to have a clear governance of the network, meaning the roles, the responsibilities and mainly the decision-making process of all the participants of the network. But from the interviews, another kind of governance was suggested: the governance of the system. This refers to the management of the blockchain itself. Who writes the codes, who has which rights and powers on the blockchain, who is responsible for its maintenance? These are also key factors in a blockchain implementation. Lastly, the size and age of the organization itself has a major influence on a technology implementation. Especially in the case of blockchain, which radically changes the functioning of the organization, flexibility and elasticity are fundamental for a successful implementation. The interviewee often expressed how they saw projects failing because of the rigidity of the structure of the organization interested. Also, the kind of product or service offered by the company influences its rigidity/flexibility.

- Regulation: it is very important to understand what the regulation about blockchain is. This technology is in an early stage of its cycle and regulation is still not clear on whether to support it or be against it. Depending on the geographical location it might radically change. Decisions about if the specific product will or will not accommodate the regulation might be fundamental for the project. Another important aspect that came out of the interviews is that the regulation changes depending on the size and the kind of product or service offered by the company. In some industries regulation might be more stringent and in others more accommodating. Lastly, the interviewees showed how important it is also to understand the responsibilities in within the network. It might not be clear how the regulation protects or punishes members of a blockchain network.

The interviewees were even asked personal opinions of the future trends regarding blockchain.

The general idea that they gave was that for sure the big interest that has been experienced in the last years will slow down. And out of all the uses that are out today many of them will eventually disappear, but there will be a strong development of those use cases that are useful.

The big use cases that will keep developing will be the following:

- The supply chain: traceability of products will become more and more accurate.
- Digital Identity: every information of a person stored all in the same spot. Especially after the Covid-19 pandemic this will be very useful.
- Cryptocurrencies: there will be an increase of the use of cryptocurrencies as a substitution of the regular currencies.

The last consideration is that in the future, with the help of other technologies, the potential of blockchain will intensify. Surely, the public will get more and more in touch with the technology.

Conclusion

As said different times during this study, blockchain is indeed a revolutionary technology. It has the power of disrupting many industries and their functioning. Since its introduction to the world, it changed a lot, and its use cases grew exponentially. It went from be the underlying system of a cryptocurrency to tracking where the chicken of your supermarket comes from and what are the steps it made to arrive at its destination. Its importance is shown by the interest that many companies and not only have on the technology. In a report by Deloitte[34] they found that there is a very strong flux of investments in blockchain. The authors surveyed a sample of 1.386 senior executives in different countries. They found out that "53 percent of respondent say that blockchain technology has become a critical priority for their organizations in 2019."

After broadly exploring the different applications that have been implemented in many different companies and after listening to the interviewees' projects it is interesting to see how not only it already has a big number of different applications but also how many are still not discovered or developed. Every application seen in this study has one thing in common: it helps where there is an important flux of data. This said, it might be used in every application that consists in the gathering and the analysis of enormous quantity of data. At the current state, it does not have the power of doing that, but in the future it surely will.

It is fundamental to understand what are the changes needed and in which situations blockchain best gives benefits to the organizations. And this was the main objective of this study: studying what are the conditions that are needed to fully exploit this powerful technology. This study might be the starting point for a further and more complete study of these conditions, hoping that organization will have a clearer method to have successful blockchain implementations.

[34] Insights, D. (2019). Deloitte's 2019 Global Blockchain Survey. *Blockchain Gets Down to Business. Deloitte*.