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The Development of Scenarios in the Diffusion of Blockchain-based Technologies

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To my parents,

for giving me the freedom to make my own choices

and the support to face them.

ABSTRACT

This research has been carried out by a student enrolled in a double degree program between the business school ESCP Europe and the Polytechnic of Turin. The engineering and business background of the facilitator allowed him to analyse the most important aspects of the technology both from a technical point of view and its implications on business and management practices. The aim of this thesis is to evaluate the real impact of blockchain technology within the European Union with a particular focus on the innovation of corporate financing instruments that the technology could foster by 2030. There are in fact more and more speculation about the high technological potential that blockchain can reveal in the next future, but with growing expectations even the associated uncertainties are increasing. It is therefore essential the development of tools to address the changes that may arise in the coming years. The anticipation of technological progress and the generation of potential scenarios can help to understand the effects that could be caused by the adoption of blockchain and to carry out strategic planning based on the projections generated. This research proposes reliable scenarios on the diffusion of blockchain-based technologies, with particular attention to the implications and consequences of its adoption through the Delphi method, a multi-stage interactive forecasting technique based on the competences of experts to identify future potential developments and technological trends. In particular, this project followed the four-step procedure recommended by von der Gracht and Darkow (2010) and took advantage of a two-round consultation; the most likely scenarios have been developed on the basis of quantitative assessments of respondents as well as on their qualitative arguments.

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CHAPTER 1 - Introduction and Objectives

The work is mainly structured in three parts. The first part presents the current state of Blockchain technology, analysing the main technological aspects and how this technology can generate implications and consequences in various industries with a particular focus on financial instruments for corporate financing. The second part will present the used technological forecasting method, the Delphi methodology. The last part will analyse in detail the method used and present the results of the survey. The Delphi method is a multi-stage interactive forecasting technique based on experts qualitative and quantitative insights to identify technical developments and trends. In particular, in this research was decided to adopt the four-step procedure proposed by Darkow and Von der Gracht (2010). In the first phase there is a series of projections regarding the future of blockchain-based technologies obtained combining both qualitative and quantitative insights of experts. In particular twelve face-to-face interviews with experts were carried out at the beginning, what allowed, together with a literature review, to generate twenty projections. The second step aimed at identifying, evaluating, selecting and finally recruiting a larger panel of experts that agreed to contribute to the research participating in the two-round evaluation of the identified projections. The facilitator was able to recruit a sufficient number of international professionals, as it was required due to the European focus of the research. Furthermore, the recruited panel is sufficiently heterogeneous, presenting expertise in different fields and industries, form start-ups to academia.

Thanks to the two-round survey required by the Delphi methodology it was possible to obtain an evaluation of the identified projections by the panel of experts. In the third steps are presented the results of the surveys. Finally, the fourth step tries to analyse the Delphi's results to derive reliable future scenarios. Interdisciplinarity is important because allows to share knowledge and competences on blockchain about the technical characteristics and the related opportunities on one side and to analyse aspects from the managerial, economic and legal perspectives on the other side.

The objective of the research is to analyse the current impact of the adoption of blockchain-based technologies on firms' organizations, innovation and strategies, focusing on the opportunities that blockchain allows in regarding the accessibility to financial capital. It tries to clarify, through expert advice, which may be the real impact of a technology that has such a high degree of speculation. It tries to discover if blockchain will lead companies to more or less efficiency, if it can change their service offerings and

their internal managerial structures or all their business models by 2030. With the growing public interest in cryptocurrencies and ICOs, many firms are looking to capitalise on this burgeoning market to raise funds. Another important aspect analysed is the potential disruptive nature of the technology and the controversial debate regarding the adoption of private or public blockchains. Many actors, such as large banks and exchanges are in fact exploring Decentralized Ledger Technologies in order to adapt to the paradigm change without being disrupted and maintaining a leadership role in the market. Incumbents see in blockchain-based technologies a good opportunity to reduce their operational and transaction costs as well as risks for back-office and post-trade functions. On the other side start-ups are willing to capture part of market share within the financial service sector and bet on public blockchains to disrupt the market equilibriums.

CHAPTER 2 - A Brief History of Money

The history of currency and money could be covered in a complete degree program. This chapter attempts to synthetize it in order to provide the fundamentals steps that gave rise to the current most widely used fiat money and, in the last decade, to cryptocurrencies.

Having a look on how currency and value exchange happened in the past has also the objective to understand the main functions of a currency and apply the definitions when analysing past, present and future currencies. Apart from technical properties, such as that money should be durable, divisible, fungible, easy to transfer and impossible to counterfeit, modern economists (Mankiw, 2003) usually assign money three main functions:

- Medium of exchange: money must be exchangeable for goods and services;
- Store of value: money must serve to transfer purchasing power from the present to the future;
- Unit of account: money must operate in such a way that is possible to quote all kind of goods and services.

It is well known that the first form of trade was through barter, the activity that allowed people to exchange value by simply trading goods and services directly, without the use of an intermediary *medium of exchange*. This method was widely adopted and accepted

by villages and tribes that had similar needs and had a limited specialization of production. But in most developed and modern societies, barter suffers from the need to uncover a "double *coincidence of wants"* (William Jevons and Carl Menger, late 19th century). Assuming that everyone in the trade is both a seller and a buyer of goods and services, the seller, receiving a good or a service as method of payment from the buyer, must believe that it will be accepted by the seller she buys from.

The main problem of this system is the improbability that the needs and wants that would motivate the trade, occur at the same time in the same place. Thus, barter is time and place dependent, if someone wishes to trade fruit for wheat, she will be able to do it only when fruit and wheat are available at the same time and place and, moreover, only if someone is willing to accept the trade.

David Graeber, in his book "Debt: the first 500 years", discusses how, together with barter, some primitive societies engaged in trading activities leveraging debt. In small and trusted communities debt eliminated the problem of coincidence of wants, postponing the payment for a good or a service. This kind of *Human Economy*, as Graeber defines them, were based on tighter range, higher trust and longer term relationships, opposite to the current exchange of value that we are now used to with the use of money that leads to lower trust and short term relationships.

To avoid the limitations of barter communities started trading with primitive forms of money, according to Philip Grierson "All money that is not coin, or as paper money, a derivative of coin".

Among the most widely used forms of primitive money, we find cattle, grain, shells, teeth, tobacco. People started trading these items to obtain any kind of good or service and the seller had the possibility to trade again the amount received for something else. While better than barter in terms of efficiency and eliminating the double coincidence of wants issue, primitive money still suffers as a medium of exchange since it might not be easy to transport and might not be durable or divisible. Moreover, being normally a good, it is vulnerable to positive and negative shocks causing price volatility, being unstable as a store of value and unit of account.

A curious and different case of primitive money is represented by the *Rai of Yap*, an inland in the Western Pacific Ocean, *Micronesia*. A Rai is a large stone disk that was “minted” from the limestone deposit of the nearby island of Palau and used as a currency until the 20th century. Since a Rai stone can weigh around 4000 kilograms, it wasn’t moved when spent, but simply changed owner. All members of the small community agreed on the change of ownership and the transaction was then recorded orally, thus everybody knew who the owner was. Eventually this oral transaction ledger became the only part that mattered and even when a stone sunk while being shipped to Yap, it continued to be used as money since it still existed even though nobody had access to it.

The oral ledger attributed ownership without a single stone moving and nobody could steal a Rai from another, since everybody in the island knew exactly to whom each Rai belonged. As will be discussed later on, Bitcoin blockchain presents many abstract similarities in the way transactions and properties are accounted.

A first form of modern coinage existed in China as early as 1200 BCE when metal cowries and other figures were created and used to trade goods, but they only evolved in standardized circular coins around 200 BC.

Thus, the first appearance of coins is generally considered to be around the 700 BC in Lydia, a Greek kingdom (modern Turkey). Lydian coins were made by a mixture of silver and gold and gave birth to a standardized and institutionalized medium of exchange. Coinage rapidly spread through the Greek city-states and eventually adopted by the Romans.

Being the value of the money directly related with the quantity of valuable metal contained, problems arose with coin issuers clipping and shaving coins reducing the quantity of valuable metals in coins.

General consensus is that the first appearance of paper currency happened in China as receipts of deposits of coin currency in authorized deposit shops. Merchants then used the receipts to trade in an easier and lighter manner. By 1120 AD, the government started issuing the first generally circulating banknotes, innovation that Marco Polo described with the following words:

“With these pieces of paper, made as I have described, he [Khubilai Khan] causes all payments on his own account to be made; and he makes them to pass current universally over all his kingdoms and provinces and territories, and whithersoever his power and sovereignty extends. And nobody, however important he may think himself, dares to refuse them on pain of death. And indeed everybody takes them readily, for

wheresoever a person may go throughout the Great Khan’s dominions he shall find these pieces of paper current, and shall be able to transact all sales and purchases of goods by means of them just as well as if they were coins of pure gold. And all the while they are so light that ten bezants’ worth does not weigh one golden bezant.

Furthermore all merchants arriving from India or other countries, and bringing with them gold or silver or gems and pearls, are prohibited from selling to any one but the Emperor. He has twelve experts chosen for this business, men of shrewdness and experience in such affairs; these appraise the articles, and the Emperor then pays a liberal price for them in those pieces of paper. The merchants accept his price readily, for in the first place they would not get so good a one from anybody else, and secondly they are paid without any delay. And with this paper-money they can buy what they like anywhere over the Empire, whilst it is also vastly lighter to carry about on their journeys.”

Precious metals depositories spread rapidly in Europe and existed for centuries, but the first real public bank was the Bank of Amsterdam, founded in 1609. Amsterdam was at the time one of the major commercial centers so that the bank was tasked with bringing order and efficiency to the wide range of coinage in circulation. The bank started accepting all types of coins, valued them and gave credit as “bank money”, for which it issued a receipt and charged an administrative fee.

Initially acting only as a depository institution on a 100% reserve basis, in time however started lending money to the Dutch East India Company, an activity that is nowadays known as fractional reserve banking. This was one of the first examples of money only fractionally backed by metal deposits and represents the first step towards fiat money.

In a way that would be repeated many times along the centuries by many banks, the Bank of Amsterdam became an early victim of overly optimistic lending when the Dutch East India Company defaulted. The bank was taken over by the City of Amsterdam in 1791.

Another step towards fiat currency was made by the Bank of England, founded in 1694, that became the predecessor of all modern Central Banks, since it gained the right to issue bank notes and became a monopoly in England and Wales, becoming *de facto* the Central Bank of the UK. Bank of England remained private until 1946, when it was nationalized.

During the 20th century the US dollar replaced the pound sterling as the most important reserve currency in the world, so that the Federal Reserve became the key central bank in the world. The US dollar passed through fluctuating periods of convertibility and non-convertibility to metals, normally following the gold standard. Today all countries use a gold standard and most sovereign currencies today are fiat currencies.

During the 20th century, currencies has shown to be subject to deflation, inflation and bankrupts. Starting from the Great Depression of 1929, many other episodes followed that prove and show how the world economy can decline. Of our interest is the famous financial crisis of 2008 that lead to the collapse of the investment bank Lehman Brothers. It is right after this international crisis that the Bitcoin protocol was published by the anonymous user with the pseudonym Satoshi Nakamoto and on January the 3rd 2009 the Genesis Block was released with the first transaction of 10 bitcoins and the sentence “The Times 03/Jan/2009, Chancellor on brink of second bailout for banks”, referring to the article of the New York Times about the saving measures taken for banks after the collapse. General interpretation of the message is that Nakamoto wanted to create a new currency to eliminate banks and other intermediaries. Since 2009 Bitcoin has grown on popularity reaching a peak of $20.000 per 1 bitcoin at the end of 2017 and at the time of writing its price is stable around $6500.

Bitcoin can be considered as a private currency since is not issued by a sovereign, but differently from other private currencies (e.g. e-Gold), that were issued by a centralized or counter party, bitcoins are issued algorithmically to a decentralized group of parties. It

is a digital currency, since no physical units are available and is not pegged to any commodities or assets.

After the Bitcoin many other cryptocurrencies have been launched, with some of them showing great success (e.g. Ethereum, Litecoin, Ripple).

During the last couple of years interest for cryptocurrencies has exponentially grown, not only due to the raising price and speculation activities, but mainly thanks to the underlying technology that allows cryptocurrencies to work safely: the Blockchain. Private companies, banks and governments are rushing to understand deeply the potential of this breakthrough technology, that has the potential to disrupt many industries and give birth to completely new business models, starting from financial institutions.

CHAPTER 3 - Technology Overview

In this chapter the main characteristics of the technology are described in order to provide the reader with a general understanding of how the Bitcoin protocol work and thus blockchain technology. This will enrich the reader with knowledge that is necessary to better understand the predictions and implications that will be described in the second part of the dissertation after the analysis of the responses of the interviewed experts.

3.1. The Byzantine Generals' Problem

Building a completely distributed, but trusted system, has been a common problem that computer scientists have always tried to solve. The main challenge is to enforce trust in communications and transactions between the nodes participating in the network, a sub-set of the study of fault tolerance.

In 1982, Marshall Pease, Robert Shostak and Leslie Lamport, first proposed a stylized version of this problem, called The Byzantine Generals' Problem.

Despite many attempts (Chaum *et al.*) Bitcoin white paper released in 2008 under the pseudonym Satoshi Nakamoto, represents the best proposed solution to date and is by far the most adopted and accepted.

"We imagine that several divisions of the Byzantine army are camped outside an enemy city, each division commanded by its own general. The generals can communicate with one another only by messenger. After observing the enemy, they must decide upon a common plan of action. However, some of the generals may be traitors, trying to prevent the loyal generals from reaching agreement. The generals must have an algorithm to guarantee that:

- *All loyal generals decide upon the same plan of action and*
- *A small number of traitors cannot cause the loyal generals to adopt a bad plan"*

The Byzantine Generals' Problem, Pease, Lamport, Shostak 1982

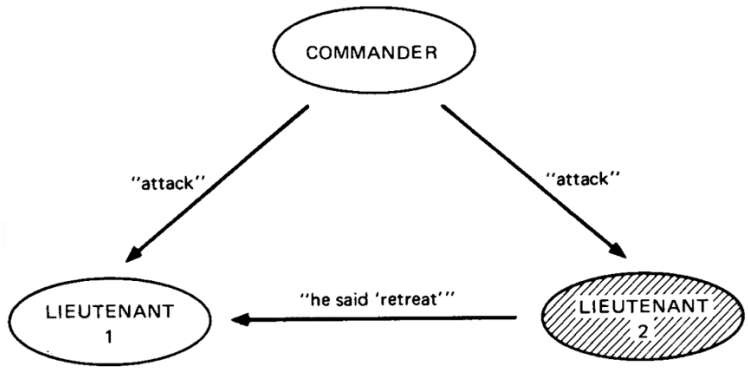

FIGURE 1 – LIEUTENANT 2 TRAITOR

Considering that three divisions are involved in the attack, divided in one commander and two lieutenants, let's suppose that Lieutenant 2 is a traitor and will then decide to broadcast a different message than the one received from the commander.

This will potentially make the attack fail, since Lieutenant 1 will receive two different messages and won't know whether to retreat or to attack.

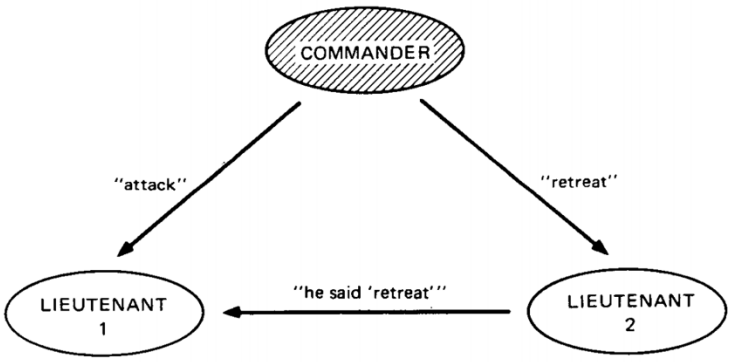

FIGURE 2 - COMMANDER TRAITOR

Even in the case in which the traitor division is the one of the Commander, the same situation occurs. The outcome is that one traitor prevents the group from reaching consensus.

If the number of the parties in the system increases, the number of channels through which malicious information and commands can propagate increases exponentially.

Thus, building consensus among millions of nodes involved in a truly decentralized system is not an easy task.

In the Bitcoin network, reach the consensus means to keep the blockchain copies in sync between the nodes and in such a way that everybody agrees in which is the chain of blocks to follow.

As a starting point a user downloads the Bitcoin “client” software that will download a copy of the ledger of all transactions occurred in the history of Bitcoin, i.e. the blockchain. In this way there is not a central keeper of the ledger, but each client holds a copy of it, storing each new record. So, the Byzantine General Problem emerges since, without a central party holding the definitive ledger, they must build a consensus deciding each time the legitimacy of new transactions and keeping the ledgers in sync. When a client receives conflicting messages, he must know which one to trust.

Bitcoin solves this problem through a process called “mining”.

When a Bitcoin client executes a transaction, (e.g. when it sends bitcoins to another client), it broadcasts the transaction to all the network, such that all users in the system receive a notification of the transaction in a few seconds.

At this moment the transaction is “unconfirmed” since it has not yet been validated by the community. Let’s suppose a case of double spending in which a client sends the same bitcoins to two different addresses, both the transactions cannot be validated, so the network must confirm only one of them.

Mining mechanism can be described as a three steps process:

1. Each miner (i.e. a full node client) creates a file, that contains:
    a. the hash that identifies the previous block, i.e. the last block of the existing blockchain;
    b. a block that contains the transactions broadcasted by the other clients that are waiting to be confirmed;
    c. a random number called “nonce”.

2. Miners hash the file using SHA-256 cryptography. They apply a function that produces a string of characters that cannot be reversed (the initial data cannot be found from the result of the hash function). Details about this step will be provided in a dedicated chapter.

3. If the hash generated matches the desired pattern, which in the case of Bitcoin is a set number of zeros in the front of the string, the block is considered valid and gains the legitimacy to be attached to the blockchain. The miner than receives a winning price, i.e. a set number of bitcoins are released and sent to its address.

If the hash does not match the pattern, it doesn’t start with the right number of zeros, the miner needs to restart from step 1 guessing a different nonce and repeating the procedure until it finds the correct one, or until another miner finds it before.

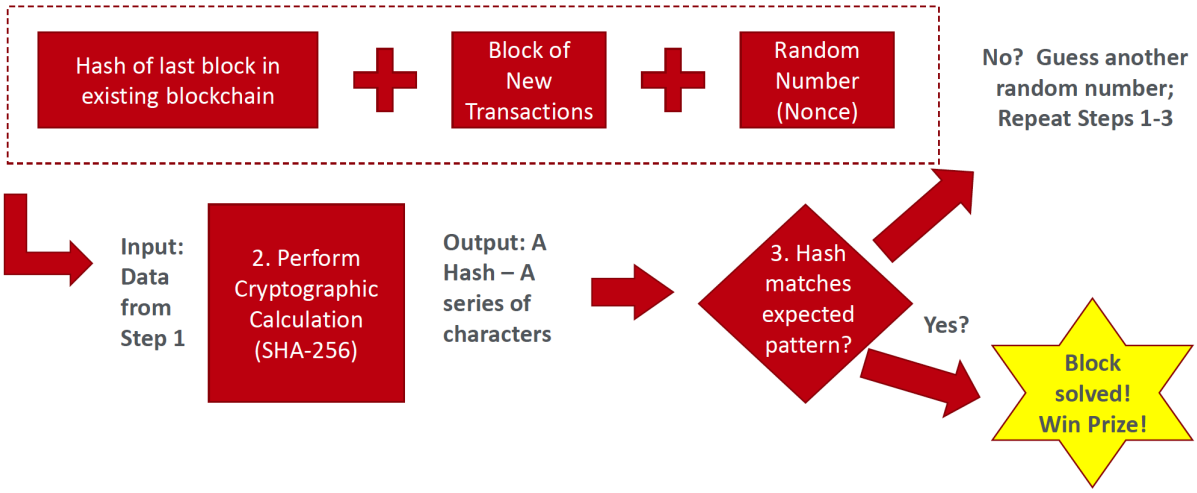

FIGURE 3 - MINING IN THREE STEPS

Once a miner has legitimate block it broadcasts it to the network as a block of confirmed transactions. All other nodes can verify that the hash matches the pattern required and will then all agree in adding it to the existing blockchain that they store. After that, a completely new block will be needed and all miners will restart the process from step 1.

The miner who wins this competition in entitled to get a set number of bitcoins that are newly generated and the transaction fees of all transactions that were included in the block. Block reward are halved every 210.000 blocks, approximately four years. It started at 50 bitcoins and it is right now at 12.5 bitcoins per validated block. Due to its deterministic nature and a fixed number of bitcoins (21 millions), block reward will stop around 2140, when block number 6.930.000 will be validated.

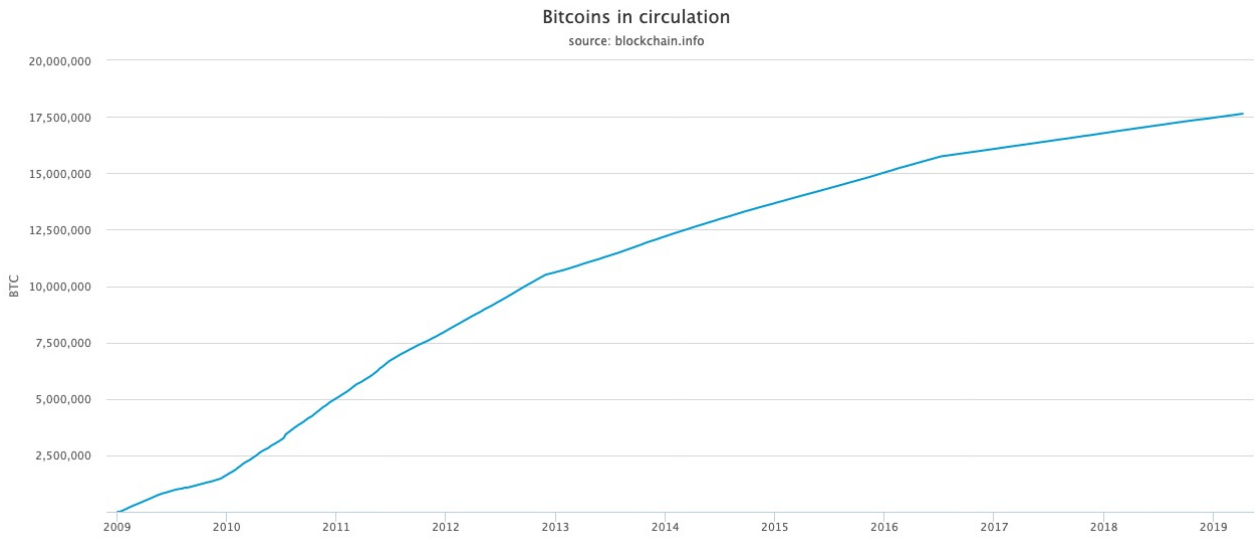

FIGURE 4 - BITCOIN MINING TO DATE

In order to keep the validation of a new block occurring approximately every ten minutes, the difficulty of finding the correct nonce auto-adjusts every 2160 block (around two weeks), by automatically increasing (or decreasing) the number of leading zeros that the hash needs to match.

This means that even if the network has a low computing power, with nodes mining with simple home laptops, or is constituted by a task force of super computers and specialized hardware, blocks will still be created every ten minutes and the expected reward of a miner is proportional to its computing power as a percentage of the total power of the network.

Going back to the Byzantine Generals' Problem, a client might find itself to choose between conflicting information coming from two different miners, i.e. which blockchain version accept.

The client must choose the blockchain that presents the greater combined difficulty of the hashes that have been used to create it. By following this rule, a client is sure to follow the longest blockchain since it is the one that took the most computational power to create.

The shorter blockchain will be discarded, leaving an "orphan block" and the transactions that were not processed in the valid blockchain, will need to be re-processed. A malicious

node, that might want to erase an occurred transaction, won't be able to do it unless she keeps producing the longest blockchain, something that is statistically impossible, since the nature of block creation is essentially random.

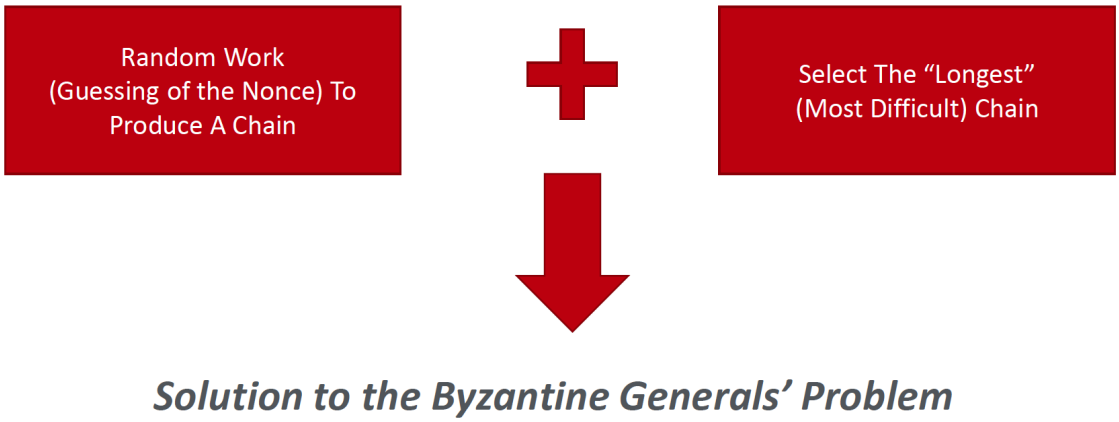

FIGURE 5 - BGP SOLUTION

This solution has been defined Proof of Work, since an actor that wants to participate to the network, proves its legitimacy and honesty by spending time and computational power. This provides ledger security and discourage malicious users from trying to manipulate the blockchain.

Proof of Work has been long debated and it is often considered as a wasted and duplication of effort and an indication of a poorly designed system.

Bitcoin enthusiast claim instead that if someone does not understand why the random number is essential for the system, she doesn't really understand how Bitcoin works.

The importance of having many nodes mining is also to prevent the system to be subject to a 51% Attack. The Byzantine Generals' Problem is in fact solved as far as honest miners hold at least 51% of the hashing power required by the network.

In case a malicious miner controls more than 50% of the hashing power, it will, in the long run, produce the longer blockchain becoming able to change her own past transactions and refuse to validate transactions from others. In other words, becoming a centralized ledger-keeper, debasing the advantages of a decentralized system.

3.2. Bitcoin and Cryptography

Bitcoin is a collection of concepts and technologies that, merged together, form a digital money ecosystem. Bitcoin works thanks to the implementation of:

- A Peer-to-Peer network
- A public and distributed ledger (the blockchain)
- A deterministic issuance mechanism enabled by mining and related Proof of Work
- A verification system of all transaction, the transaction script

Trust is enabled by cryptography technologies, specifically the cryptographic hash functions SHA-256 and RIPEMD-160 and Public Key Cryptography (i.e. ECDSA – Elliptic Curve Digital Signature Algorithm).

Transactions, the transfer of bitcoins from one owner to another, are enabled through digital keys (Public and Private), Bitcoin addresses and digital signatures.

The former are a Private-Public key pair, that is created offline mathematically using ECDSA. The private key is generated randomly and must be kept secret. It is used to sign the transaction and it enables the receiver to verify the authenticity of the sender, by proving the match with the public key, which is derived from the private key through an irreversible hash function.

The Bitcoin address is generated using firstly the SHA-256 and then the RIPEMD-160 on the public key. Ultimately addresses are encoded using Base58 to make it human readable.

The hash function serves to verify the integrity of data, by transforming data into a unique fixed-size code (e.g. SHA-256 returns a string of 64 hexadecimal characters).

The Keyhash is generated applying in series the RIPEMD-160 and SHA-256 to the Public Key generated through the ECDSA by the Bitcoin client software. The Data is a concatenation between the Keyhash previously generated and 1 byte version number. The Datahash is produced by applying SHA-256 hash function twice on Data and the first four bytes of the output are used as Checksum.

An address is then a concatenation between Data and Checksum ecoded with Base58.

In Figure 6**Errore. L'origine riferimento non è stata trovata.** and Figure 7 is represented a scheme of the algorithm.

```
version  = (1 byte version number)
keyHash  = RIPEMD-160(SHA-256(publicKey))
data     = version + keyHash
dataHash = SHA-256(SHA-256(data))
checksum = (first 4 bytes of dataHash)
address  = Base58Encode(data + checksum)
```

FIGURE 6 - ADDRESS GENERATION

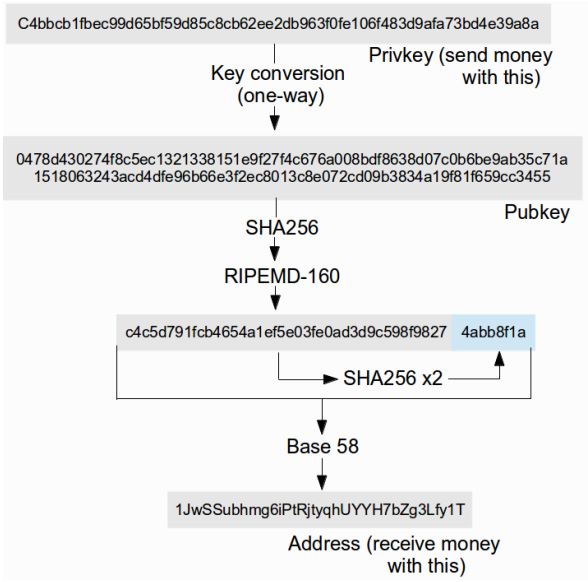

FIGURE 7 – CRYPTOGRAPHY

To assure data was not modified or corrupted during the transmission to the network, so to verify data integrity, the SHA-256 codifies the transaction securing it, since any modification to the data, intentionally or accidentally, will change the resulting hash code.

Even though all transaction information is publicly visible, and transactions are not encrypted, Bitcoin uses digital signatures to verify those transactions broadcasted to the network and avoid double spending.

The sender can encrypt the message “M”, called plaintext, using the Public Key (K_{pub}) of the receiver, generating a message C = encrypt(M, K_{pub}), called cyphertext. The receiver can decrypt the message using its own Private Key (K_{priv}) associated to the Public one and she will be able to return to message M=decrypt(C, K_{priv}).

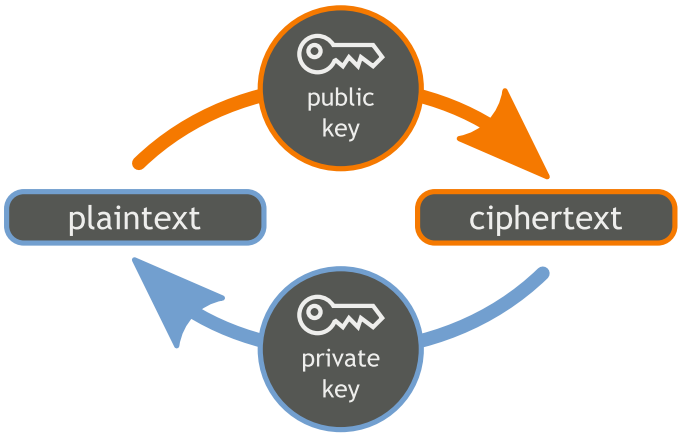

FIGURE 8 - PUBLIC KEY CRYPTOGRAPHY

The asymmetric relationship between the private and public key, allows the encryption algorithm to be swapped. The sender can then encrypt (sign) the message M with its Private Key, such that C=encrypt(M, K_{priv}) and the receiver can verify the validity by decrypting the message using the associated Public Key of the sender, thus M=decrypt(C,K_{pub}).

This algorithm is used by Bitcoin to digital sign each transaction. A hash function is firtly applied to the plaintext before encryption, so to maintain always the same length.

To summarize, when a transaction occurs, a certain amount of bitcoins are associated to an address, produced hashing the owner’s Public Key, and it includes a valid transaction signature stating that a quantity of the bitcoins are sent to another address. When

broadcasted to the network, every peer knows that the new owner of those bitcoins is the receiving address. Through the decryption of the signature anyone can verify that the transaction is authentic, and it will be stored by every peer contributing to the network, so anyone can verify at any time which is the address owning a particular amount of bitcoins.

Bitcoin addresses, similarly to credit cards, do not store any bitcoins, but only the public-private key pair that allow the access to the funds.

But since the blockchain is a sequence of blocks linked together that contain transactions, hash functions also assure the integrity of all the block and the chronological order of the chain, so that changes of ownership cannot be altered by malicious activity.

Furthermore, as already mentioned, hash functions are of key importance to enable the Proof-of-Work algorithm.

3.3. Transactions

As already mentioned, a transaction is the authorization that the owner of a number bitcoins gives to transfer some of these bitcoins to another owner, broadcasting her decision publicly to the network.

Transactions work similarly to a double entry book-keeping ledger, in which *inputs* are debits against a Bitcoin address, and *outputs* are credits added to a Bitcoin address. Differently from traditional double entry book-keeping inputs and outputs, don't need to sum up to the same value, but instead outputs are slightly less than inputs, being the difference the transaction fee that goes to the miner who included the transaction in a valid block.

The simplest and most common transaction is the transfer of some bitcoins from one address to another that, unless sending all the bitcoins, presents a change that will return to the sender. This kind of transaction has one input and two outputs, as transaction A (TX A) in Figure 9 - Transaction.

Another common transaction is the one that aggregates several inputs into a single output, see transaction B in Figure 9 - Transaction. Finally, another transaction can be the distribution of one input to multiple outputs, representing several recipients.

From Figure 9 - Transaction it is clear how outputs from a previous transaction become the inputs for the next one and so on.

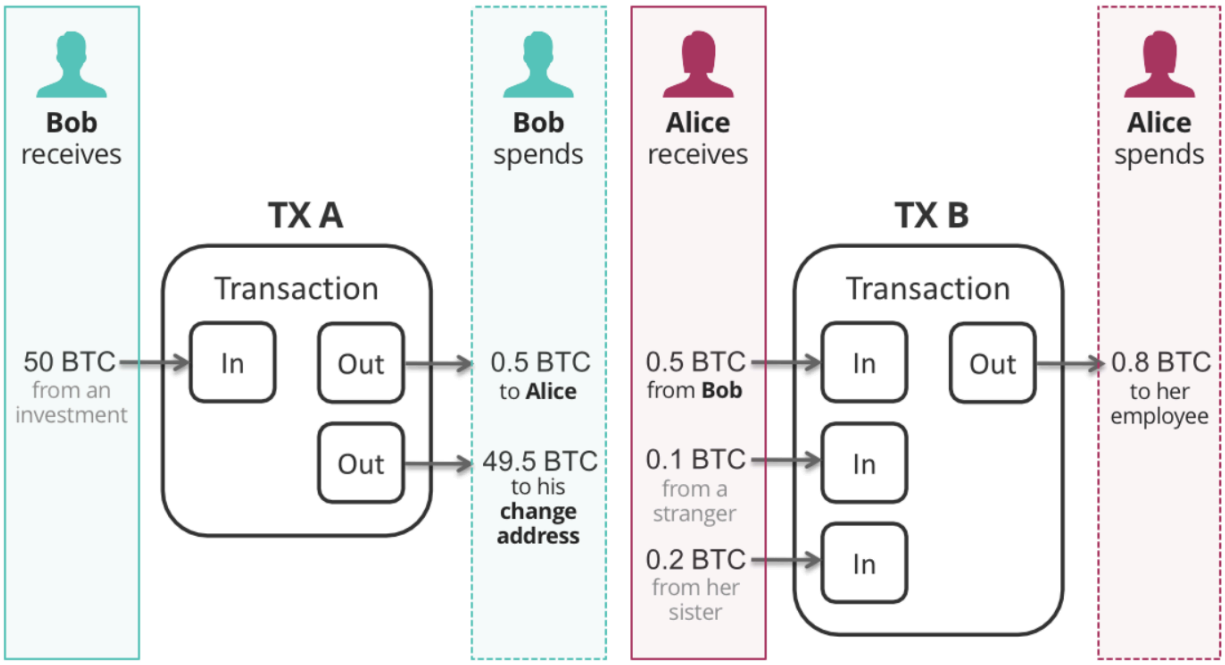

FIGURE 9 - TRANSACTION

In the figure below the first transaction ever performed: 10 bitcoins sent from Satoshi Nakamoto to Hal Finney the 12th of January 2009. The transaction shows one input and two outputs, being 40 BTCs the change. Moreover, is presented the block reward of 50 BTCs that have no inputs since are newly generated coins.

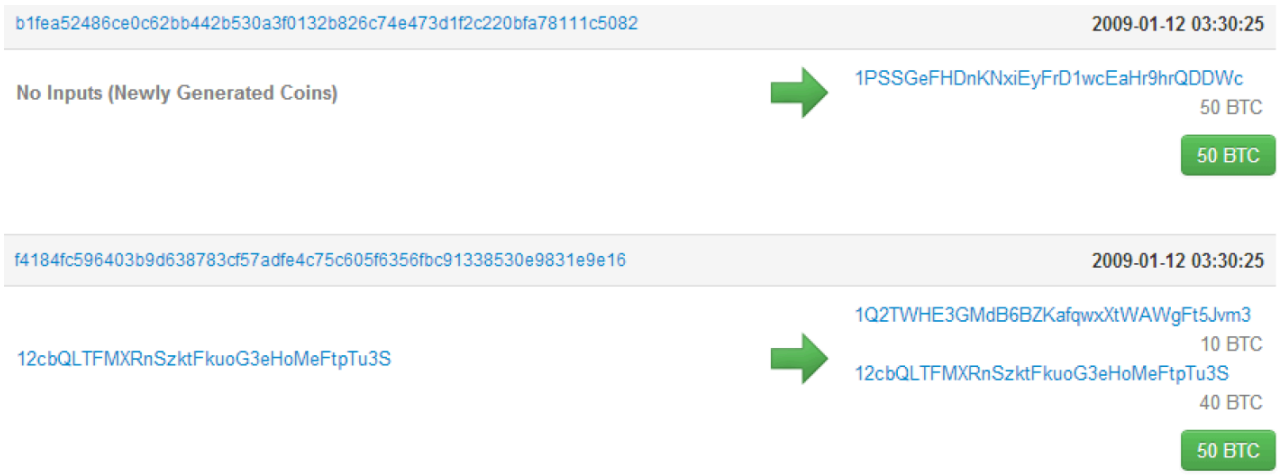

FIGURE 10 - FIRST TRANSACTION

3.4. Mining

As already described as a solution to the Byzantine Generals' Problem, mining has two main functions:

- It grants trust within the network, by ensuring that all transactions are confirmed only after a certain amount of computational power was used to validate the block that contains them (Proof of Work)
- It allows the generation of new bitcoins, that are released mathematically every time a new block is validated. The amount of bitcoins created each time is fixed and diminishes with time at a fixed rate (see chapter 0).

Since mining is a core element for the functioning of the Bitcoin network and it must be understood to have a clear idea of how a blockchain can be set up, the main steps of the mining algorithm are recalled:

1. A miner can arbitrary choose among the transactions that are broadcasted to the network and bundles them together into a block;
2. It verifies that all transactions are valid;

3. Selects the last block of the longest blockchain and adds its hash into the header of the new block;
4. Simultaneously tries to solve the Proof of Work problem to find the correct nonce and watches for new blocks coming from other nodes (if some other miner found it first). If a solution is found, it attaches the block to the blockchain and broadcasts it to the network.

Proof of Work consists of the following steps:

a. Increment the arbitrary number of the block header, the nonce, adding 1;
b. Take the hash of the resulting block header;
c. Verify if the hash expressed as a number is less than a required target value, i.e. presents a required number of zeros in the front.

Due to all the computational power that is required, mining performance is measured in hashes per second. At the end of August 2018, the estimated number of tera hashes per second reached by the Bitcoin network was higher than 60.000.000 TH/sec (source: blockchain.com).

There are different ways to contribute to mining and add computational power to the network.

Using a personal computer, or a specialized mining hardware, trying to validate a block and get all the reward (prize plus transaction fees) is defined as solo mining. This type of mining was efficient in the early years of Bitcoin when difficulty was low.

As difficulty increased miners decided to collaborate merging together their hashing power and run it as one account. When a block is validated the reward is given to the one address used and then distributed to all the miners who contributed to it proportionally to the share of power they contributed with.

Different hardware can be used to mine, but today, only ASICs are economically efficient.

- CPU: initially user's PC hardware was efficient enough to solve the PoW;
- GPU: Graphic Processing Units are order of magnitude faster than CPUs, processing mathematical calculations in parallel, but still general purpose;
- FPGA: Field Programmable Gate Arrays is an intermediate hardware between a fast processor and ASICs;

- ASIC: Application Specific Integrated Circuits are customized for a specific application. In Bitcoin they are programmed to perform only SHA-256 hashing functions.

3.5. Wallets and Clients

Andreas M. Antonopoulos in his book *Mastering Bitcoin* defines a wallet as: “software that holds your addresses. Use it to send bitcoins and manage your keys”.

We already explained that ownership of bitcoins is established with a private-public key pair. These keys are generated on Bitcoin end-user’s computer using a software called *Bitcoin client.* Once created, they can be stored wherever, a file, a database, a paper, but most commonly are stored in a Bitcoin Wallet.

Exactly like an email address, Bitcoin address are shared to other users in order to receive payments, but differently from email, many addresses can be used and all of them direct payments to the same wallet. A wallet is then a collection of addresses and the keys that unlock the funds associated.

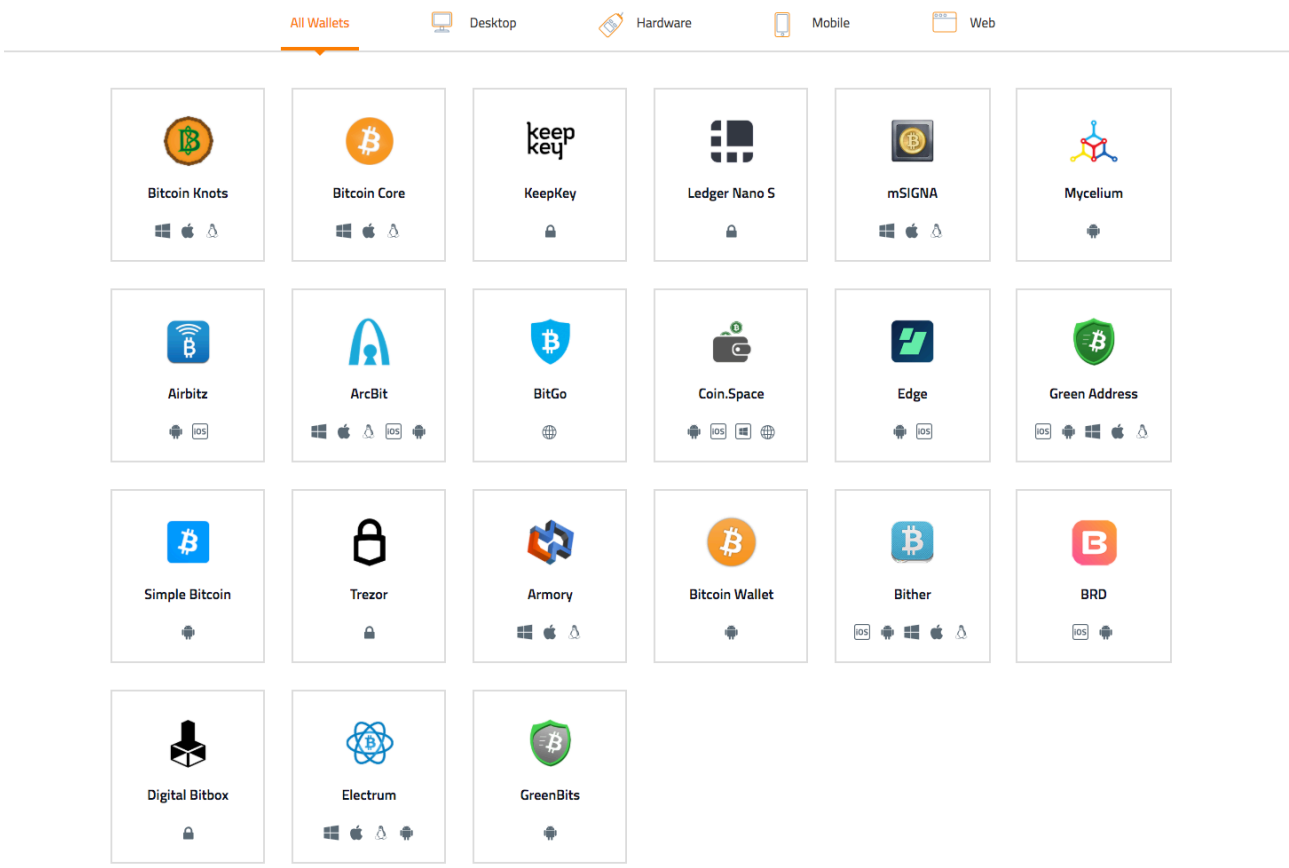

FIGURE 11 - BITCOIN WALLETS (SOURCE: BITOCOIN.ORG)

The terms Client and Wallet are often used interchangeably, for the purpose of this dissertation, they are defined as:

- A Wallet is a collection of data (private-public key pair and addresses) used to send and receive bitcoins;
- A Client is a software that connects a user to the Bitcoin network handling communication, updating funds and signing outgoing transactions.

(source: bitcoin.stackexchange)

There are different types of Bitcoin clients:

- Full client: stores the entire history of transactions, manages the wallet and can communicate transactions to the network. It does not rely on any third-party server. Private keys are stored locally and never communicated;
- Web client: the wallet is stored on a server owned by a third party and the user accesses it through a web browser. Private keys can either be only stored in the third party's server (e.g. Coinbase), or they can also be decrypted and be stored locally by the user (e.g. Blockchain.info);
- Lightweight client: stores the wallet and the private keys locally but relies on a third-party server to access the history of transactions and the network. In this case the user trusts third party servers for the validation of transactions, since it doesn't store a copy of it. Keys are stored locally like in full clients;
- Mobile client: it can either be a full client, a lightweight or a web client and operates on a smartphone. Some mobile clients are synchronized with their desktop version, providing multichannel access to the funds.

Storing the wallet locally or remotely is a choice that considers the level of security one would like to have. Storing keys locally on a hardware means that if the access to the device is compromised (hacker attack, crash) and no backups are available, private keys, and therefore bitcoins, are lost forever. Remote storage relies instead on the level of security of the third-party servers, thus if compromised, or if the third-party acts maliciously, bitcoins will be probably lost. Often exchange websites, that act as web clients, provide the possibility to change password in case the user forgets it, thus this allows the user to take less security measures, delegating it to the provider.

Another way to protect against hackers and server failures, is cold storage. Cold storage means securing a reserve of bitcoins offline.

True cold storage refers to generating the keys offline and the keeping the device where they are stored always offline, even for signing transactions. This is impractical, and it is used only for large funds that are not moved often.

Conventional cold storage instead means that the keys are stored offline, but the hardware where they are kept goes online to sign transactions.

Hardware for cold storage include USB drive, paper or a specific offline Bitcoin hardware wallet.

3.6. Forks

Since the software is open source anyone can change it and create a similar version, generating its own blockchain and cryptocurrency, or try to update the existing model.

In the history of Bitcoin this type of attempts have generated variations that are based in the same underlying concepts but are different from the original one. This process is known as forking, through which the Bitcoin community divides and the blockchain is split in two.

Satoshi Nakamoto in his Whitepaper describes forking as follows: *"They vote with their CPU power, expressing their acceptance of valid blocks by working on extending them and rejecting invalid blocks by refusing to work on them. Any needed rules and incentives can be enforced with this consensus mechanism".*

A *soft fork* represents a change to the Bitcoin protocol in which updated nodes start operating with the new rules, while old nodes can keep validating blocks as valid. Soft forks are backwards-compatible.

A *hard fork* represents instead a radical change in the set of rules that old nodes cannot follow and won't be able to validate the blocks. The nodes that will accept the new rules will upgrade to the new version and start mining the new blocks (join the fork), while the ones that are contrary to the changes will keep mining old blocks on the old chain.

Of course Bitcoin has seen many debated hard forks, some of which were almost unanimously accepted by the community and didn't generated a new branch, while others in which a high percentage of miners didn't agree and headed to the creation of a new currency and blockchain (e.g. Bitcoin Cash).

Following a list with a brief description of the most relevant forks that Bitcoin spawned during the years.

3.6.1. Bitcoin XT

Bitcoin XT is considered the first real hard fork of Bitcoin. The software was released by Mike Hearn at the end of 2014 and aimed at including several new features. Mainly the new version allowed to increase the number of transactions per second, from seven up to 24, by increasing the block size from 1MB to 8MB.

Initially the fork was a success, with more than 1,000 nodes running its software at the end of summer 2015. But a few months later, the project was largely abandoned, even though technically available and feasible interest has fallen out.

3.6.2. Bitcoin Classic

Bitcoin Classic was launched at the beginning of 2016, with the aim to increase block size to 2MB and allow a faster transactions per second rate. After a great initial success, with about 2,000 nodes during 2016, interest declined. The project still exists today and some developers strongly supporting Bitcoin Classic, but the greatest part of the community moved to other options.

3.6.3. Bitcoin Unlimited

Bitcoin Unlimited allowed miners to decide on the size of their blocks, with a limit of 16 megabytes. The type of fork required was not specified by the project's developers and despite some interest, Bitcoin Unlimited never gain wide acceptance.

3.6.4. Segregated Witness

The idea was presented by Peter Wuille, Bitcoin core developer, in late 2015. SegWit aim was to reduce the size of each bitcoin transaction, allowing more transactions to take place at once. Presented as a soft fork, it prompt hard forks after it was originally proposed.

3.6.5. Bitcoin Cash

Bitcoin Cash was one of the hard forks that SegWit2X generated. A group of Bitcoin developers and users didn't agree with Peter Wuille and wanted to avoid the protocol

updates. They divided from the main blockchain in August 2017, with Bitcoin Cash wallets rejecting Bitcoin transactions and blocks.

Bitcoin Cash represents the hard fork of most success. It allows blocks of 8 megabytes and did not adopt the SegWit protocol.

3.6.6. Bitcoin Gold

Following Bitcoin Cash, in October 2017 some developers wanted to restore mining difficulty in such a way that was possible to use GPUs and not specialized equipment.

Thus, Bitcoin Gold equals Bitcoin in many of its basic principles, but differs in terms of the proof-of-work algorithm miners are required to solve.

3.6.7. SegWit2x

After SegWit released in August 2017, a second upgrade was meant to occur in November 2017. SegWit2x, through a hard fork wanted to allow block size of 2 megabytes. However, a wide part of the community who adopted SegWit was against the implementation of SegWit2x and the team announced on the 8th of November the cancellation of the hard fork. In few years, Bitcoin has already produced a large number of forks. It is likely that both soft and hard forks will continue to occur growing the cryptocurrency community and involvement. Bitcoin is a first application, but it opens a broad range of opportunities fostering innovations that were not imaginable before.

3.7. Alternative uses of the Blockchain

The open-source characteristic and thus the possibility to modify the Bitcoin model, generated many other coins and layers upon it with different applications and rules.

3.7.1. Alt-coins

Altcoins are the result of the hard forks, therefore by mining with different consensus rules miners will start effectively a new Blockchain with its own currency, a scarce token

generally called alt-coin. Most famous altcoins generated from the Bitcoin blockchain are Litecoin, Dogecoin and Peercoin.

Often are also named altcoins cryptocurrencies, generated completely anew, starting from scratch their own blockchain. The most successful altcoin of this type is represented by Ethereum.

3.7.2. Meta-coins

If a company would like to take advantage of the Bitcoin blockchain infrastructure, but would like to add some specific consumer or enterprise services, it is possible to develop a protocol that is built on top of Bitcoin, i.e. a different layer, with its own cryptocurrency.

As an example, a concert organizer could create its own tickets (tokens) and sell them. Eventually people who can prove that they are the holders of the tickets, according to the records kept on the Bitcoin blockchain, will be allowed to enter. This is a simple use case of digital-ticketing but shows how such a market could be disrupted by achieving the same result, without passing through third party entities, such as *Ticketmaster*, that keep the bookings and charge fees.

3.7.3. Coloured-coins

The basic concept that lays behind coloured-coins is that of attributing to existing and simple bitcoins another additional value. If a group agrees that a fraction of bitcoins, not only has its intrinsic abstract value, but also another one, they can be potentially designated to transfer that value altogether. Coloured coins extend bitcoins with further properties, effectively turning them into tokens that can be used to represent anything. An example could be a number of bitcoins representing 1000 shares of a company, by sending them, both bitcoin value and the share ownership is transferred.

Of course, transactions must follow a tagging algorithm that “colours” the selected bitcoins (tagging-based colouring). Examples of coloured coins are *Coinprism*, *ChromaWallet*, and *Coinspark*.

3.7.4. Attestation

Another important characteristic of the blockchain is its “attestation”, or “remote attestation”, ability. The Bitcoin protocol allows authenticated nodes participating to the peer-to-peer network to monitor the behaviour of other nodes. If a malicious or unproductive behaviour is detected, the misbehaving node can be banned through global consensus.

This ability unlocks many further interesting applications.

Most of digital certificates, such as passports, identity cards, driving licenses, nowadays are released by a centralized authority that is trusted and authorized in issuing and certifying the ownership of a document. Leveraging blockchain decentralization, zero-knowledge proof concept and the Bitcoin infrastructure it is possible to build a trustless decentralized digital notary.

A notable example is Namecoin that allows domain name registration and transfer identity information in a completely decentralized manner, through the use of a decentralized DNS for .bit domains.

Other examples are represented by Blockstack and ProofOfExistence, digital notary projects that allow users to certify any kind of document by timestamping them on the blockchain.

3.7.5. Sidechains

Sidechains are a new innovative concept that allows users not only to transfer bitcoins to other addresses, but also to other blockchains at a deterministic or fixed exchange rate. These blockchains operate in a completely independent manner and run in parallel taking advantage of Bitcoin blockchain, which takes the name of *parent chain*.

Sidechains allow to implement changes, or solve some issues, while preserving the architecture of the parent chain (e.g. introduce a higher level of anonymity). By creating an alternative chains they allow the creation of alternative coins or assets (e.g. smart contracts), pegged to bitcoins scarcity and supply.

Bitcoins are sent to a special address that locks the bitcoins and a token is generated transferred on an address of the sidechain owned by the same user

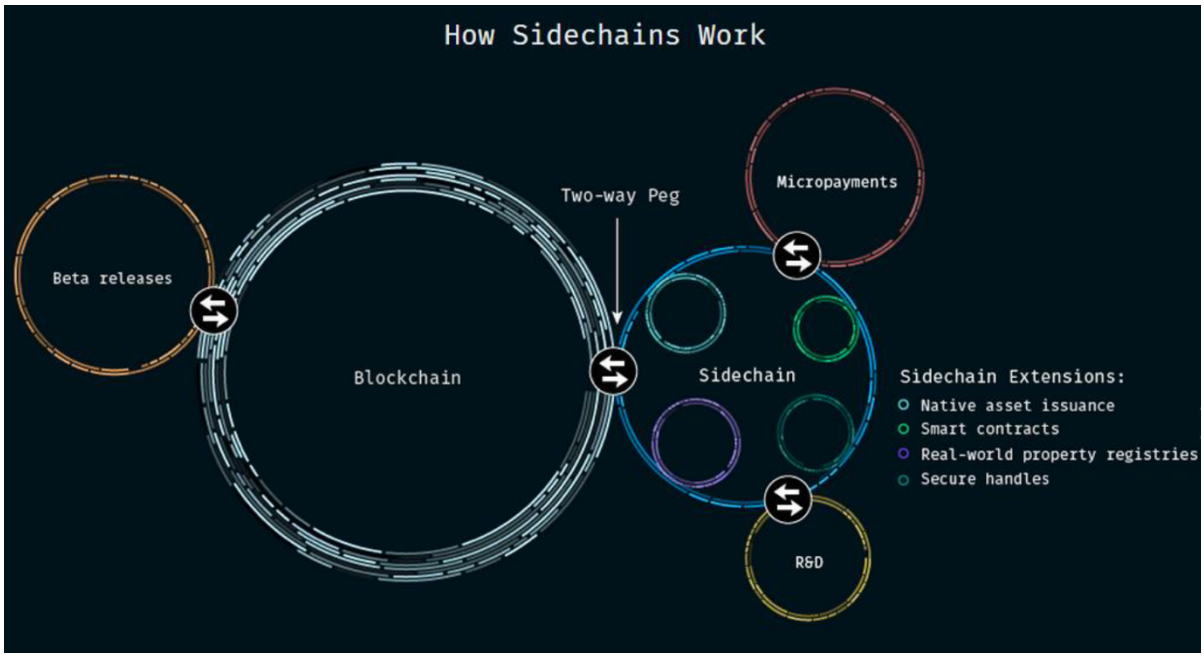

FIGURE 12 – SIDECHAINS (SOURCE: BITCOIN MARKET JOURNAL)

Sidechains can have other sidechains for things like micropayments. They allow for experimentation and pre-release versions of future sidechains or even a Beta version of Bitcoin itself.

3.7.6. Smart Contracts

Smart contracts are the automatic implementation of agreements reached by two or more parties.

If obligations are met, the contract is automatically self-enforced and implemented using software. As for Sidechains the technological issue is solved by building upon the existing infrastructure a layer.

Smart contracts thus enforce power equality among all parties involved and they protect the rights of all individuals by assuring reasonable conditions and expectations for the signee. Furthermore, they eliminate the possibility for a signatory to avoid her obligations.

3.7.7. Financial Contracts and Instruments

Most financial instruments are essentially a contract depending on the issuer and the set of rules or dependencies set by them. The compliance and respect of these rules, by both the issuer and the instrument user, is monitored by relevant security and exchange providers. By issuing financial instruments as a specific type of smart contracts, the adherence to the set of rules and regulations will be assured, eliminating the need of a third party, and everything will be managed by math (these math algorithms are called Oracles). Oracles for example are able to hold the funds of the parties involved until the conditions (internal or external) of the investment are met (e.g. price below a certain value, duration…) and pay out the relative amount to the investors. Everything in an objective and transparent manner and without the need of any kind of trust between the parties involved. Derivatives market is one of the largest in the financial world. Basically, every type of asset can be traded in the market in the form of futures or options. The biggest pool in the futures market is represented by commodities and currencies, while stock options and indices are traded in the options market. Trading has always been done in centralized exchanges (e.g. CME Group and Eurex), but technology allowed to disrupt the industry so that many traders now can access trading platforms online.

Experts believe that the concept of *Smart Contract* embedded in blockchain technology could disrupt how derivatives market works. Their self-enforcing and self-executing nature that allows parties to transact transparently, accurately and efficiently, makes them a perfect means for those markets that are built on systems with clear rules and quantifiable terms of agreements (e.g. insurance, real estate, banking). An important issue centralized exchanges face is the cost of the fees charged by brokers that act as intermediaries, with smart contracts this obstacle can be avoided. Due to the high volatility bitcoins and other cryptocurrencies present, investors seek for purely speculating activities, which is still the main usage the crypto-community performs. Since its beginning bitcoin-backed financial instruments have struggled to be legally accepted and traded. The Commodity Futures Trading Commission (CFTC) approved in 2017 bitcoin futures contracts, making of bitcoin an accepted asset class, but the lack of a system of derivatives around Bitcoin has caused some problems when attempting to approve Bitcoin-ETF. The Security and Exchange Commission (SEC) has decided to postpone the decision about Bitcoin-ETF approval on August 23rd 2018. Two main types of ETF were proposed: one based on bitcoin futures contract, so it doesn't store any real bitcoin,

the second instead was a physically backed ETF, meaning that the fund buys a set amount of bitcoins and stores it in its own secure storage system. Despite the approval decision has been postponed experts consider the former ETF type more promising. Besides the bitcoin future contracts approval of 2017, a futures-backed-ETF exhibits some advantages such as the opportunity to buy futures contract on predicted price movements (this could make it profitable for investors even if the price drops). The fact that the fund doesn't need to store any bitcoin makes it more secure and relieves it from the need to safeguard from thefts or hacks.

CHAPTER 4 - The Blockchain: Trend Overview

The great potential of the blockchain is that of possibly substitute all Centralized Ledgers, those that present a trusted party functioning as a record-keeping, that we take for granted, since a valid alternative solution has never been presented.

In modern society all ledgers are in the hand of third parties, from bank accounts and local land registries, to the records relating to citizenship, but centralized ledgers are not perfect. They can act as gatekeepers, thus deciding whether a transaction can be executed, not always are trustworthy and present the main drawback of being a single point of failure (SPOF). Bitcoin blockchain represents the first practical manifestation of a Decentralized Ledger that could potentially substitute all ledgers, not only currency. The high excitement for a decentralized ledger lies on the fact that transactions and property of assets is approved and registered by a community of actors involved in the network that do not necessarily need to trust each other. This is why is often referred to as a trustless system. This democratic and shared methodology allows great advantages such as the avoidance of censorship and exclusion, invulnerability to malfeasance by record keepers and protection against the loss of records. The Bitcoin blockchain has given for the first time the ability to transfer digital property from an internet user to another, in a safe and secure way, with everyone knowing when and that the transfer has occurred, such that nobody can claim or challenge the legitimacy of the transfer. Consequences of such a revolutionary paradigm are hard to overstate and understand. Like for all the inventions that have shaped the modern age, such as the personal computers in 1975, the internet in 1993 or the iPhone in 2007, there is a part of the society ignoring it and

sceptical about its potential and, on the other hand, technologists and innovators who instead show a high interest, spending time and effort in trying to take a competitive advantage from it, sometimes magnifying and exceeding the possibilities of the invention.

In a moment of great expectations and trepidation about blockchain technology, this dissertation tries to objectively understand its potential and the industries that will be affected by 2030.

4.1. The FinTech Revolution

Over the last centuries, the financial sector has been growing and expanding its businesses into not only banking, but also security firms, insurances, real estate. Financial companies are mostly considered as service providers supporting firms in to conduct their business. Technology evolution has helped at improving efficiency in organizing things, coordinating processes and performing tasks more easily since the adoption of physical media containing simply the information of value (e.g. banknotes) to facilitate transportation and trade. With the arrival of information and communication technology physical representation of value started to be less used leaving space for more digitalized forms opening trades to a global market.

By the late 1980s financial services became a largely digital industry relying on electronic transactions. The digitalization brought to a drastic reduction of the number of banks, but an increase in the number of employees (i.e. manual workforce). Between 1980 and 2009, the number of institutions diminished from 37,090 to 15,801 in the US and from 3006 to 1774 in Germany (OECD 2018). In contrast, the workforce grew from 2,019,341 (1990) to 2,302,628 in the US and from 495,700 (1980) to 633,550 in Germany (OECD 2018). Though, the digitalization process has been slow, and inefficiencies have led to a fertile ground for the FinTech movement that also benefited from the 2008 financial crisis. Inside this turbulent situation, blockchain quietly arose and only in the last few years financial institutions and companies have really started investing in projects related to the technology, with a peak of investments in 2017 and 2018. The graph below indicates the investments done by VCs in blockchain related projects.

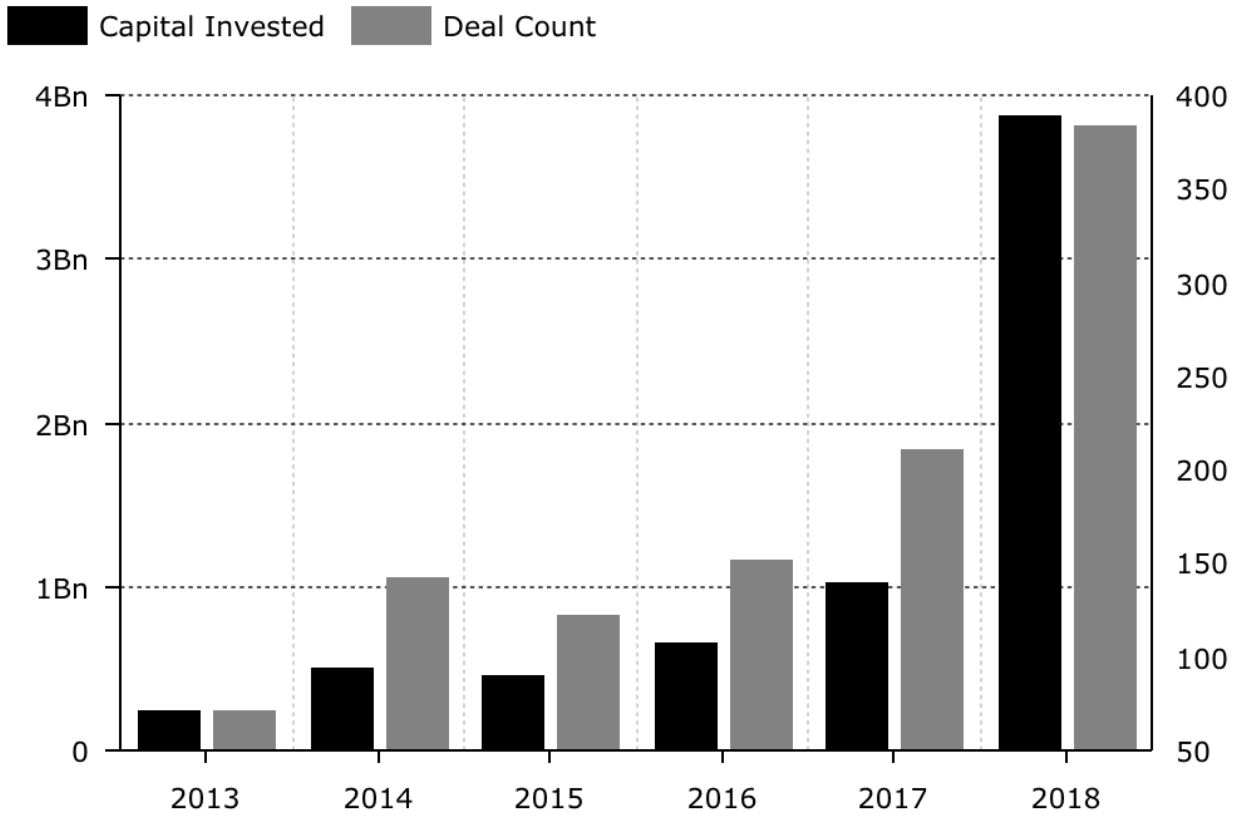

FIGURE 13 - VENTURE CAPITAL FIRMS BLOCKCHAIN INVESTMENTS - SOURCE: DIAR

4.2. Emerging trends in blockchain technology

According to the research *"What's Next in Blockchain"* carried out by *CBInsights*, blockchain is evolving in many industries and at different pace. In the figure below gives a general overview of the main trends that involve now the adoption of the blockchain in its plurality of adaptations, DLTs, DAPPs and cryptocurrencies and positioning each trend using the NExTT framework. The first dimension, market strength, takes into account the availability of a strong demand and scalable opportunities based on quality and number of investors and capital, investments in R&D, earnings transcript commentary, competitive intensity, incumbent deal making (M&A, strategic investments). The second dimension, industry adoption, analysis how much the trend is widespread and understood among industries, based on the number of startups in the space, media attention, customer adoption (partnerships, customer, licensing deals). Evaluating these two dimensions, trends are divided in *transitory*, *experimental*, *threatening* and *necessary*. The NExTT framework helps businesses understand trends in accordance to their risk

level and uses data-driven signals to evaluate products, technology and business models from early stages to maturity.

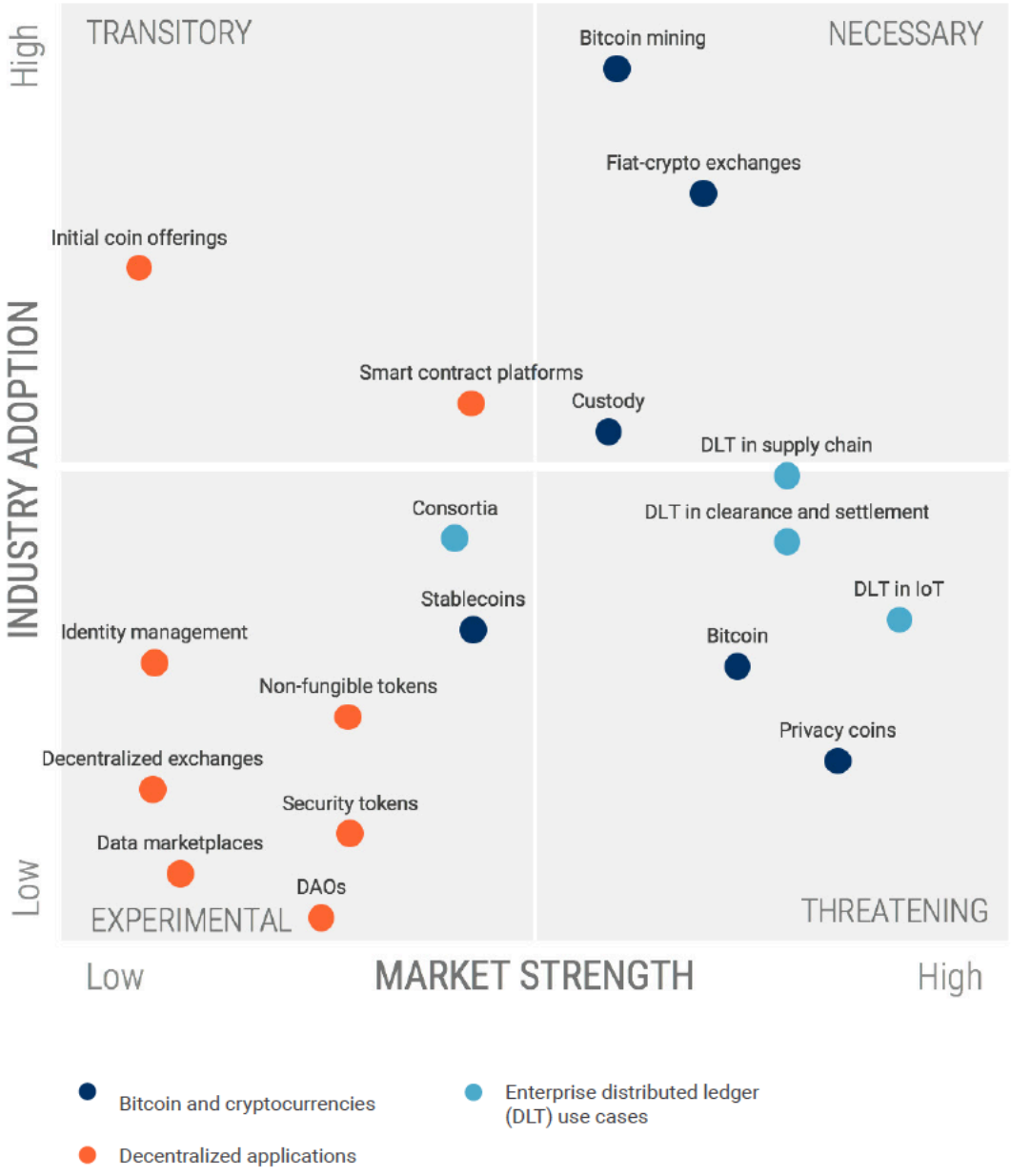

FIGURE 14 - EMERGING TRENDS NEXTT FRAMEWORK - SOURCE: CB INSIGHTS

Transitory. If the market strength of the use case is low, but the use case had been widely adopted, it is marked as transitory. This is the case of ICOs that have exploded in 2017, but that are facing uncertainty about market opportunity. As transitory trends become

more broadly understood they may reveal additional opportunities for the markets, this is the case of smart contracts that are now seeing increasing opportunities as they become more stable.

Experimental. Experimental are those trends in early-stage, that have few functional products and have still not proved to be a good investment (e.g. Data marketplaces, DAOs, Decentralized Exchanges, Identity management) or face a lot of regulatory restrictions (e.g. Security tokens, Non-fungible tokens). Use cases of this category have media attention and are now generating proof of concepts. Consortia are still in an experimental phase due to frictions of legal entities and because competitors are averse to collaborate sharing data.

Threatening. The trend is embraced by early adopters and might gain widespread industry or customer adoption soon since high investments are made, and they address a large market. In this category we find all DLTs that try to solve blockchain problems of performance, for example allowing IoT transactions. Bitcoin blockchain is in this category since the largest blockchain community works on it and many efforts are being made to improve its performance (e.g. Lightning Network).

Necessary. Those trends towards which incumbents have, or should have, a clear strategy and initiative. Use cases have a large and widespread adoption and industry implementation and market potential and applications are well understood. In this category we find Bitcoin mining and fiat-crypto exchanges.

4.2.1. Bitcoin Mining

Mining companies are facing right now a decrease in demand and issues regarding environmental sustainability of their business models. The increasing competition of new entrants also is damaging the industry lowering margins and ROI. In this situation companies such as Bitmain are thinking about going public to decrease the risks. Most investments are made in order to design and produce more powerful chips able to process faster the algorithms. To lower environmental impacts related mainly to the “Proof of Work” algorithm of Bitcoin, developers are trying to propose different mining algorithms (e.g. Proof of Stake, Proof of Burn) that will eliminate the high need of power. If more blockchains will opt for alternative consensus algorithms, mining companies will

see a drop in their return of investments and lost revenues. Due to the decrease in demand mining companies are opting to expand in other adjacent sectors (e.g. Bitfury raised $80M to expand into markets like artificial intelligence, and Bitmain has also is exploring AI). These challenges show that mining is a sub-sector of the entire blockchain industry that is right now mature and profitable, but needs to strategically think about its next steps.

4.2.2. Fiat-crypto Exchanges

Exchanges still represent the first way people gets cryptocurrencies allowing them to trade fiat currencies such as euros and dollars for cryptocurrencies such as bitcoin and ether. Main reasons of the activity are speculation followed by long term investments and portfolio diversification. Exchanges generate their revenues thanks to transaction fees, but they are now facing a decreasing revenue due to a slowdown of speculation activities. To counter attack exchanges are now allowing customers to invest in more cryptocurrencies adding them to their list and launching new trading products. For example, the Chicago Board of Options and Exchange (CBOE) now offers bitcoin options, and ICE (owner of the NY Stock Exchange) is planning to launch bitcoin futures next year. One of the main threats for fiat-crypto exchanges is whether the biggest financial institutions will enter the market stealing their market share, and some are on the way to start the competition. Another important issue exchange need to face is to find a business model that doesn't rely merely on speculation and investment activities, thus they should foster a broaden use of the assets investing on the development of performant use cases.

4.2.3. Custody

A big issue that discourages big investments in cryptocurrencies is custody, i.e. the ability of financial institutions to hold the investments on behalf of third parties. Reliable solutions available in the market are very expensive, whether if digital or physical opting for cold storage custody systems (e.g. Xapo, a bitcoin-only exchange and storage service, operates inside a decommissioned Swiss military bunker to protect users' coins and keys. The ultra-secure site has steel doors that can resist a nuclear blast and uses methods to prevent electromagnetic pulse (EMP) attacks). As VCs, hedge funds and traditional finance investors are looking forward to entering the crypto-market, solutions must be

found to provide a reliable custodial infrastructure at accessible costs. By reassuring investors that their assets will be safe, cryptocurrencies will make a step forward to *cross the chasm (ref. Roger's curve)* and be widely adopted.

4.2.4. Decentralized Exchanges

All major exchanges operate in a central manner, by enabling transactions and for this the charge fees. Decentralized exchange plan to use the blockchain in order to provide customers the possibility to exchange without the approval of a middleman. This kind of business model faces lot of restrictions since in such an exchange any kind of token could be bought or sold, participants could be completely anonymous, and no authorities could shut it down. It is hard to foresee how these applications will be able to be compliant with securities laws, such as KYC.

4.2.5. Consortia

Making competitive firms collaborate is not an easy task and this is one of the main reasons why consortia have not seen a widespread adoption. Blockchain and distributed ledgers need a collaborative environment and work properly only if among participants there's a common willing and desire to make it work efficiently.

Another big issue stands on the legal side that still requires a lot of paper to be signed and approved slowing down the technology that instead could work faster. Most successful consortia are those ones addressing specific problems of an industry, directing efforts to improve a particular issue shared among large firms. Big firms adopting DLTs solutions for their operations can leverage over suppliers forcing them to adapt. This is the case of IBM's distributed ledger service that has worked with big corporate players like Walmart, Kroger, and Nestle, using Hyperledger for supply chain management.

4.2.6. Security tokens

A centralized ledger tracks asset movement within the financial system between institutions, whereas a distributed ledger eliminates the need for central authorities to certify asset ownership since transactions are verified by many institutions. The latter solution requires assets to be digitally represented on a blockchain system, named

“security tokens”, but that can still be subject to formal security regulations enforced for financial instruments such as bonds, stocks and other types of securities. Through the adoption of smart contracts security tokens can be programmed in order to act in a certain way and be enforced automatically without the need of a third party. But satisfy the needs of many stakeholders is not easy since they would see their usefulness diminished, for example the need of public registries in the case of land registry. Security will need regulatory compliance also in terms of law enforcement in case something goes wrong. Whose responsibility will be in case of a malfunction?

A shared ledger for security transactions will also allow almost real time clearing and settlement eliminating the need of reconciliation of duplicative records and thus reducing counterparty risks and the capital requirements associated to the delays. With the current financial system clearing and settlement activity can take from days to weeks for certain types of bonds. Efforts are also made to create a distributed ledger able to manage cash flows, collateral management and other derivatives-related work flows aiming at providing a standard set of digital definitions and smart contracts.

4.2.7. Non-fungible Tokens

Non-fungible tokens are those tokens that within a blockchain network are unique and distinguishable from one another and are also not interchangeable. Use cases executing these kinds of tokens are emerging in the gaming industry. An example is *Decentraland*, a game in which users build virtual reality real estates by using a token called *land*. The blockchain ensures scarcity of lands and property rights.

Another Ethereum-based game is *Cryptokitties* that got really high media presence and success at the end of 2017. The game consists in generating new kitties by breeding existing ones Each of them has a unique digital DNA and thus is different from all others. Non-fungible tokens promise to establish digital scarcity, allowing digital ownership, and his unique characteristic the way to experimenting them with for example digital art masterpieces, AR/ VR experiences.

4.2.8. Data Marketplaces

Artificial Intelligence requires access to massive datasets that needs to sort and analyse in an efficient way to make accurate predictive models and this is why leaders of the market are companies like Facebook, Amazon, Microsoft, Google (FAMGA) and Chinese Baidu, Alibaba and Tencent (BAT), all companies that offer a widespread service and have access to immense data about users' behaviour. Blockchain could help SMEs and startups that don't have access to those massive amount of information by creating a marketplace allowing organization to share their data and thus the implementation of projects in need of big quantity of data. This system will lower transaction costs that companies right now incur due to legal terms and data leakage.

These kind of sharing own's data could find also applications in final users who might decide to share their data with advertisers and marketers in exchange of royalties or a contribution.

4.2.9. Decentralized Autonomous Organizations

Blockchain has a potential to disrupt organizational and corporate structures by allowing self-executing companies that do not require owners. These companies could get access to capital through fundraising without stocks or financial infrastructures or pay employees without knowing their names. DAO (Decentralized Autonomous Organization) was the first attempt, made in 2016 using Ethereum blockchain in order to generate a VC fund through crowdsourcing. The project failed due to a bug in the code that a hacker discovered and the hype around DAOs suddenly decreased. But some blockchain companies are still working on the concept aiming at creating digitalized legal jurisdictions that could regulate a community to resolve disputes and other efforts are made on projects to build decentralized storage services (e.g. Filecoin and Golem offer peer-to-peer networks that pay users to lend out idle hardware for various tasks). In 2018 Vitalik Buterin (Ethereum founder), published a paper describing an improved version of DAOs, integrating an ICO. The new model is called DAICO and differently from the DAO, the funds are not fully available right after the token sale, but they are stored in a virtual fund and developers can access to a limited amount to it, increasing depending on how successfully the team achieves the promised results. If investors are not satisfied with the

results obtained by the company can reduce the amount of money developers have access or also decide to invest them in some other project, abandoning the initial one. Briefly DAICOs give investors the right to control the process of money flow. The model is very young and presents vulnerabilities, but the community is working and will probably improve it in the future, with the promise to reduce fraudulent projects, attracting investors to real promising start-ups.

4.2.10. Identity Management

Blockchain represents a tool that will allow users to directly control their own digital identities, rather than being subject to technology giants. Internet giants have a revenue stream coming from collecting, selling and analysing user data on behalf of advertisers. An example is the Facebook single sign-on that allows users to sign in to other websites using their Facebook credentials giving the company a massive amount of data for targeted advertising. With blockchain identity could be verified on an open public blockchain without the need of an enterprise to do that, but this kind of system faces oppositions from governments since traditional ID systems, such as the security number, help keeping track of the citizens with a high degree of control. By managing identity on a public blockchain governments should give up their role of ID issuers.

4.2.11. Clearance and settlement

Clearance and settlement operations are still quite inefficient in the banking industry and blockchain technology is a promising solution to improve time-consuming processes related to them. If banks use the same shared database clearing and settling transactions between them can be nearly instant. Instead of relying on a network of custodial services and correspondent banks transactions can be settled directly on an open and transparent distributed ledger resulting in time and cost savings. Many projects aiming at building an adequate infrastructure have already been started meeting some objectives and results, so it is reasonable to believe that DLTs between banks will be used in the near future.

4.2.12. Bitcoin

Ten years after its appearance bitcoin is still not widely accepted as a form of electronic cash and its use case remain unclear. A part the problems related to volatility and thus transaction fees, most consumers prefer other form of peer-to-peer payments systems such as WeChat, Venmo and Zelle instead of crypto based ones like Circle or Coinbase.

Bitcoin enthusiasts though still believe in its potential and consider that it will first become a recognized form of store of value and increasingly gain acceptance to become a medium of exchange. The graph below illustrates a possible optimistic view of Bitcoin acceptance.

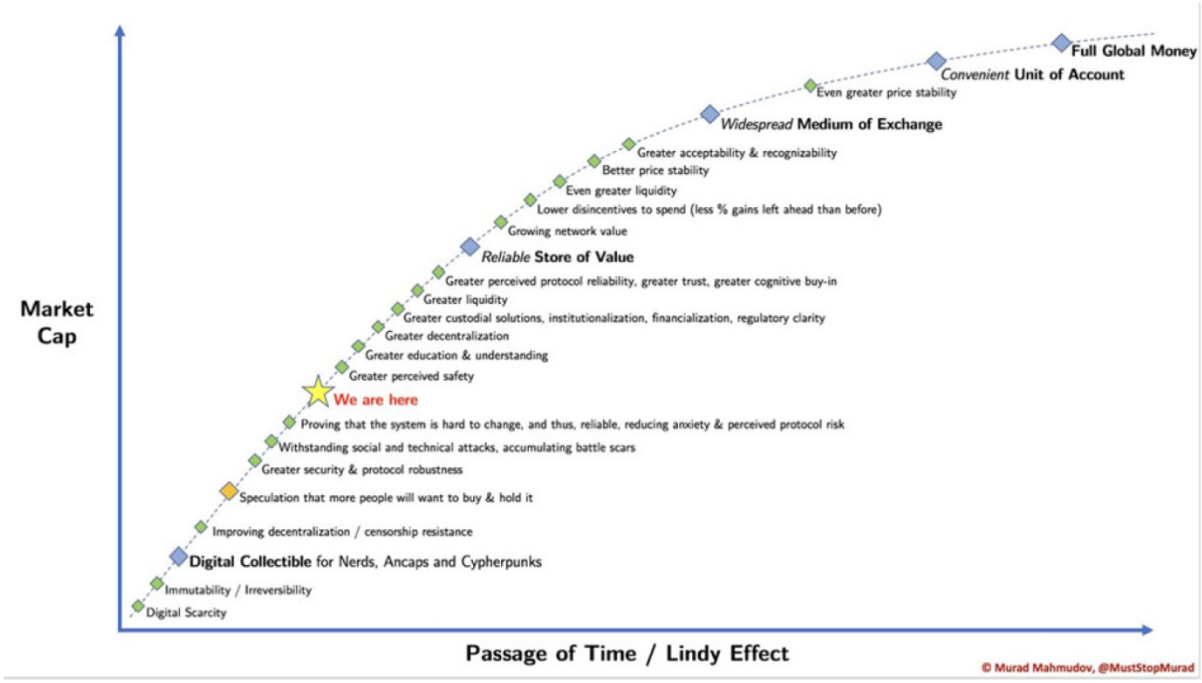

FIGURE 15 - BITCOIN MARKET CAPITALIZATION - SOURCE: MURAD MAHMUVOD

In countries where inflation is very high people buying bitcoins are mainly doing it for hedging, rather than simply speculating. This is the case of countries like Venezuela and Argentina.

In countries where there are severe restrictions about export of capital, such as Iran, bitcoins are used to transfer capital in foreign countries eluding governmental restrictions.

With the introduction of Lighting Network, implementation of second layers networks will be possible, allowing to process more transactions at a lower costs and thus opening the way to instant payments.

4.2.13. Privacy Coins

For bitcoins the transfer from a public address to another is entirely public and thus specialized law enforcement agencies are able to track the movements avoiding nefarious and illegal usage. Due to this pseudo-anonymous characteristics, other cryptocurrencies were developed with the aim of creating full anonymity. The network and the protocol is very similar to the Bitcoin one, but guarantees a higher degree of privacy. Examples are Monero, ZCash, Horizen and Dash. These coins are known as privacy coins and are widely associated to the black market and this is why it is likely that centralized exchanges are not willing to list them due to more stringent regulatory regimes such as KYC, though at the time of writing major exchanges (e.g. Coinbase and Gemini) are listing them. With the development of decentralized exchanges as seen in chapter 4.2.4. it is reasonable to believe that the adoption of privacy coins will see an exponential growth.

4.2.14. Supply Chain

The global supply chain presents a high degree of complexity, due to the many actors involved and thus many different types of record-keeping methods from database to emails and paper documents. For example, shipping company Maersk found out that for a single container, approvals of thirty parties d authorities are required during a shipping cycle.

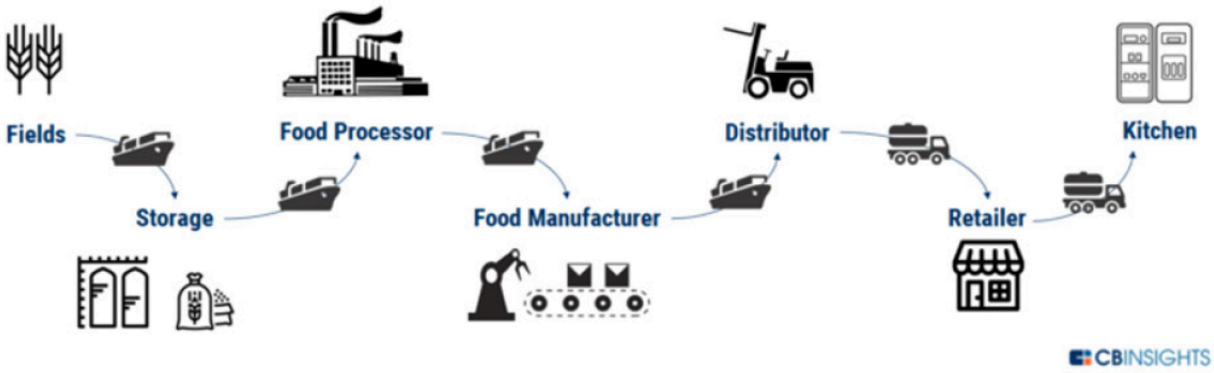

FIGURE 16 - THE COMPLEX GLOBAL FOOD INDUSTRY - SOURCE: CB INSIGHTS

Blockchain promisingly could be used to document all the transactions involved and taking action among the actors in a distributed, open and real-time database. Such a system reduces delays, increases transparency, and reduces human errors. Major logistic giants, such as Maersk, are experimenting now decentralized database to manage their shipments and many corporates will follow suit if the use cases will be proven successfully. Distributed ledgers will see a rapid growth and an increase degree of innovation in the logistic sector.

4.2.15. Internet of Things

Internet of things is widely used in industrial environments to digitized physical processes. Companies are monitoring machines and their productivity thanks to connected devices during the manufacturing and shipping processes. Distributed ledgers are promising to enhance IoT systems allowing all parties involved, manufacturer and suppliers, to have access to the data analysed by connected sensor in the assembly line, knowing for example the status of the product in question. The real challenge for IoT specific distributed ledger is how they will prove themselves to be a better choice in terms of performance against existing technologies. Relational databases and RFID tags are in many cases of enough value and a distributed ledger would overcomplicate operations.

4.2.16. Initial Coin Offerings

Initial coin offerings are a method used by start-ups and companies to raise funds. They issue tokens in exchange of fiat money to finance their project promising that their tokens will have some kind of utility once the project will be running and adopted. ICOs enthusiasts argue that issued tokens cannot be seen as unregistered securities, but this is not the point of view of regulators such as the SEC, that in June 2018 declared that most ICOs are unregistered security offerings. After the great success of 2017, ICOs have dramatically dropped, due to bans and fines of governments and law enforcements institutions that pointed them as scams and illegal activities. It seems then that a centralized company selling tokens through a blockchain system will find hard times in the future if they are not compliant with regulations that of course lower the potential of the instrument. However, according to a Deloitte study, as the market matures more structured and planned models to issue tokens are emerging around four main characteristics:

1. The amount of money that will be raised has a limit in order to lower volatility;
2. Time limit on token sale allowing buyers to decide the most appropriate time to invest. The most common structure makes the token sale ending when the time limit or the total amount of token is reached;
3. Transparency on the total amount of token issued and who holds them (e.g. owner, developers) and automatically restrict the creation of new tokens and making it clear to investors;
4. The value of the tokens relates to fiat currency and is derived from the percentage that will be sold and the value raised.

Despite the difficulties and challenges that issuing tokens through ICOs are finding, they still represent an instrument that has the potential to democratize entrepreneurship and innovation.

- Fundraising. In the case of fundraising for example, entrepreneurs right now must rely on angel investors or VCs at an early stage or decide to opt for crowdfunding platforms like Kickstarter. ICOs allow to raise funds from all kind of investors across the world without taking into consideration their profile. ICOs can democratize and globalize access to capital that right now remains very limited and is highly

localized with investors focusing on opportunities within their network or local communities.

- Investments. Many investors are still interested in blockchain tokens, as they still offer very attractive returns and good opportunities for investment diversification. ICOs give the opportunity to invest in early-stage ventures that normally only professional and accredited investors have opportunities to see. Furthermore, blockchain tokens are highly liquid, as they can be directly traded on digital currency exchanges, allowing investors to cash out when they need to.
- Wealth sharing. Blockchain tokens represent also a mechanism of wealth sharing enhancing the creation of user and developers' communities. Traditional early-stage platforms can give discounts or services for free to incentivize network effects that are key for the success of a platform: they help to attract new users and to design and develop complementary products. Blockchain tokens give a financial incentive, that will compensate early adopters for the limited usefulness of the platform, thus facilitating its adoption and diffusion.
- Open source. Taking into consideration open source projects, blockchain tokens can support their continued development and still compensating core developers. Even though open source projects create tremendous value for the society, they still suffer of poor financing that can hamper their development. An example is Wikipedia that often needs to ask for small donations from users. With blockchain, open source projects can raise funds not by asking for donations but by issuing tokens, capturing some of the value they generate. Distributing a substantial number of tokens through an ICO to core developers will motivate and incentivize them to further improve the platform.

4.2.17. Smart Contract Platforms

A smart contract is a code placed in a blockchain that is enforced automatically when conditions are met. Ethereum holds a leading position in the development of smart contracts, but consumer adoption remains very limited. One reason is that community sees Ethereum as a poorly designed protocol that has seen in the past episodes of centralization concerning decision making of the protocol. Thus, other smart contracts platforms have arisen to compete against Ethereum. Such companies are Tezos, Hedera Hashgraph, and Dfinity. With competition arising, smart contracts represent a promising

aspect of blockchain technology development. Even small business could benefit from this trustworthy automation. An example are escrow services, a business that is worth billions of dollars. Instead of having a third-party charging fees to hold a purchase fund until conditions are met, the buyer could simply send tokens to the seller's address that will remain blocked until the program acknowledges that the required steps have been completed. Once all the requirements are all met, the tokens are transferred to the seller. Smart contracts can also be multisignature, allowing a third party to verify the conditions and the necessary documents.

4.3. Cryptocurrency and Central Banking

Central banks are the entities that define and manage the monetary system of a country, or more countries.

Briefly central banks are responsible for:

- The creation of regulations national banks should follow and respect
- The issuance of money and the control of money supply
- Loans of last resort for national banks or other eligible institutions
- Monitoring the inflation rates and the credit/debit position of the nation

The ultimate goal of central banks is to pursuit monetary and financial stability, fostering international cooperation. In the following table the main functions of central banks are compared with cryptocurrencies in order to understand which of these functions might be substituted by the new paradigm.

TABLE 1 - CENTRAL BANKS VS CRYPTOCURRENCIES

Central Bank General Functions	Central Bank Detailed Functions	Cryptocurrencies
Monetary Stability Functions	Monetary Policy	Yes. Monetary policy fixed at inception, but can be changed by majority of miners. In the case of Bitcoin, it is mildly inflationary (expansionary) money supply but with the rate of increase dropping rapidly over time
	Exchange Rate Policy	No
Financial Stability & Regulatory Functions	Prudential Policy Supervision	No
	Supervision/Oversight	No
Policy Operation Functions	FX Intervention	No
	FX Reserves	No
	Liquidity Management	No
	Lender of Last Resort	No
Financial Instrastructureand Provision Functions	Currency Provision	Yes, through block rewards
	Banking/account management services	No
	Payment system (inter-bank)	Yes
	Settlement system of central bank money	Yes
	Other settlement systems	Cryptocurrencieshave a built in payment system that, from one point of view, merges a variety of traditional payment and settlement systems
	Registry Provision	No
Other Public Good Functions	Debt Management	No
	Asset Management	No
	Development Functions	No
	Research (other for the functions above)	No
	Statistics	All data produced by the system is publicly available
	Consumer Services	No

As we can see from table 1, cryptocurrencies cover only few of the functions executed by central banks, primarily they might substitute a monetary policy, introduce a different payment system and are able to issue new currency.

If we look at the advantages that introducing cryptocurrencies might produce:

- Money supply would not be subject to political interventions and decisions, avoiding inflation due to increases in money supply. History has proven that many fiat currencies have failed due to external events (e.g. wars and natural disasters) and over-issuance;
- Seigniorage benefits (i.e. benefits received for issuing new units) accrues to miners according to the costs they incur providing security and stability to the system and not to political entities;
- A public and open database with auditable models increases transparency and reduces possibilities of fraud;
- An open market competition of private currencies will generate efficient outcomes (Austrian economics philosophy), since the issuance algorithm is public, and people might consider it desirable or not.

On the other hand, considering central banks point of view, there are factors to be considered that favour the adoption of a centralized system:

- The ability to interfere on inflation rates and money supply allows nations to control the price of money. With cryptocurrency system the price is subject only to changes on demand and no actions can be taken to counteract volatility. Managing money supply allows to stimulate economic growth and unemployment. Most cryptocurrencies would find difficulties in fostering growth during recession periods;
- Nowadays most people prefer to give up some independence in exchange for less day-to-day personal responsibilities of fraud, thefts and wealth and financial management in general;
- The ability of being a lender of last resort in order to save banks or other institutions is of key importance to take action during critical situation that would damage a vast part of citizens.

4.3.1. ECB position about cryptocurrencies

The first relevant analysis about the Bitcoin and decentralized currencies led to a pronouncement in February 2015 that defined Bitcoin as "*a digital representation of value, not issued by a central bank, credit institution or e-money institution, which in some circumstances can be used as an alternative to money*".

Three virtual currency schemes were defined based on observed characteristics and usage and according to their interaction with real money (legal tender currency) and real economy.

1. Type 1 refers to virtual currencies used in a closed environment, such as games;
2. Type 2 refers to virtual currencies that interact with the real economy in a unidirectional manner (usually inflow);
3. Type 3 refers to virtual currencies that interact in a bidirectional manner (inflow and outflows)

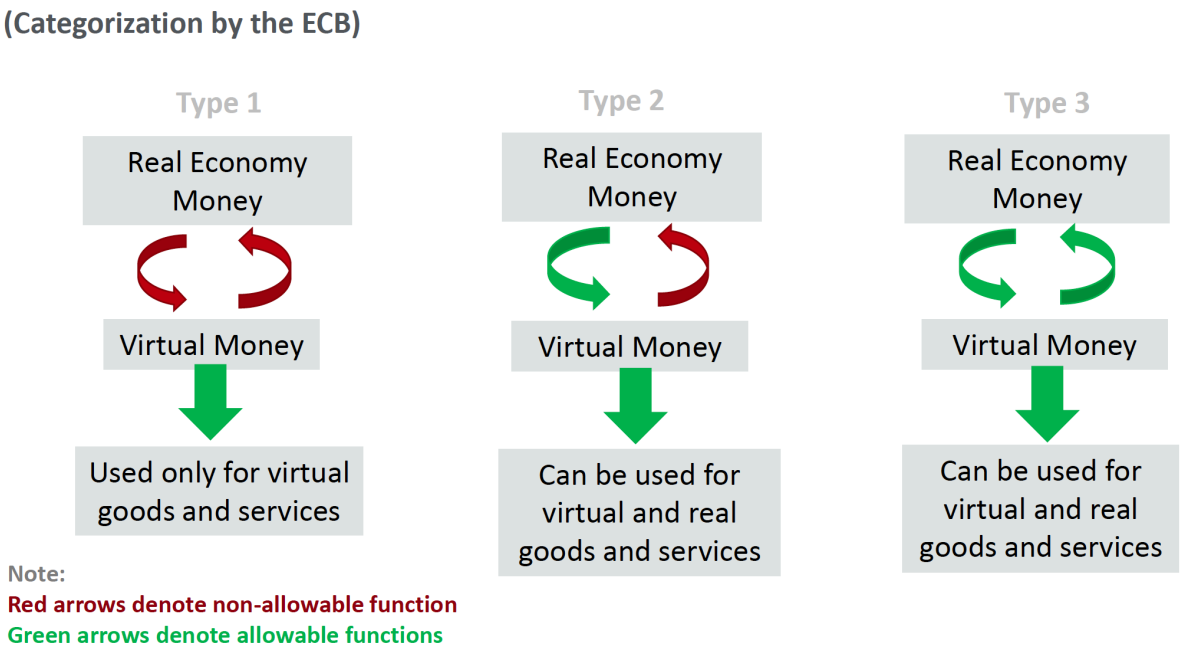

FIGURE 17 - VIRTUAL CURRENCIES INTERACTION

According to a paper released in October 2017 that analysed electronic payments and contracts the definition was expanded to the more general term of *virtual currencies* defining them as "*digital representations of value which, despite not being issued by a central bank or another, comparable public authority, nor being 'attached', subject to certain exceptions, to a fiat currency, are voluntarily accepted, by natural or legal persons, as a means of exchange, and which are stored, transferred and traded electronically, without a tangible, real-world representation".*

This new definition allows a broader use of virtual currencies, making them eligible for trading transactions on a voluntary base. Though virtual currencies are not object of a unique and harmonised regulation. The president of ECB Mario Draghi declared on February 2018 that is not responsibility of the ECB to regulate Bitcoin or other virtual currencies. He added that he expects blockchain to bring many benefits, such as a possible use as a method of payment. All European institutions are showing interest on the technology but consider virtual currencies not yet safe and they are willing to investigate more.

4.4. Blockchain for Crowdfunding

4.4.1. Methodology

First, an extensive search has been conducted in the titles and abstracts of published, peer-reviewed articles in the main electronic reference retrieval service Scopus, using a series of keywords that cover the topics under scrutiny. The selected keywords have been the following ones: Fintech, blockchain, ICO, DLT, corporate financing, crowdfunding. It followed a selection of all the relevant research published in academic journals during the last three years, from 2016 until 2019. In this phase, were taken into analysis all the articles pertaining to the topic on how blockchain is fostering or could possibly facilitate corporate financing providing different services and products.

Second, a manual screening of the papers identified was performed in order to validate the search terms and to filter the preliminary list according to fit and thus remove all the articles that did not fulfil the research topic.

Third, the selected papers were classified into three major research streams that have emerged in the last decades:

i. The crowdfunding opportunities that might arise on top of blockchain-based technologies
ii. The implications of an unregulated market for investments for the raise of fintechs
iii. The globalization effect when it comes to investments and funding through blockchain

Finally, after having read and analyzed each selected article, a detailed database was created in which we have coded the following information: (1) author name(s), (2) article title and journal of publication, (3) research question(s), (4) data used, (5) research methods, and (6) findings.

4.4.2. Literature review

The main theoretical and empirical evidence is synthetized hereafter along the three identified research streams and summarized in Table 1.

i. The crowdfunding opportunities that might arise on top of blockchain-based technologies

Blockchain technologies might trigger and foster new forms of crowdfunding activities, starting from the Fintech environment. Crowdfunding allows firms to raise capital in the form of equity online. Since 2016 it was allowed in the US to take advantage of this methodology to finance businesses. The developments and research on this field have opened the way to explore alternative methods for financing startups, many of them technology based. This need has arose due to concerns related to information asymmetries that emerged between those entities that can be considered insiders, such as VCs and PEs, and external shareholders. The introduction of this new form of raising funds had huge corporate governance implications (Ahlstrom et al). Young innovative firms have troubles in finding the needed amount of funds, which limit their growth and threaten their survival. Lack of internal cash flows and collaterals, as well as asymmetric information and agency problems, are the main reasons for the difficulties in raising external funding (Block et al). But the emerging trend of crowdfunding, brought many legal and ethical concerns, since firms would pay less attention to due diligence checks and prefer opportunistic behaviors, taking advantage of backers whose investments are relatively low (Ahlstrom et al). Still, having access to more and fresh capital improves the

chances of success of those businesses that managed to avoid governance issues, the major cause of failure after being financed through crowdfunding (Ahlstrom et al). Advanced technologies in the last decade have allowed for greater competition in small business lending, getting funds from lenders with no local presence (Jagtiania et al). That competition between banks and Fintech challengers has given way to direct collaboration across the Fintech ecosystem. But crowdfunding platforms play a substitutional role for traditional financial intermediaries serving as a new intermediary, such that they do not solve the need of eliminating intermediation (Weiyi Cai). Virtual currencies like Bitcoin and associated technologies can change the business models of existing players in entrepreneurial finance (Block et al). This is why crowdfunding and blockchain can be regarded as two innovations that may disrupt traditional financial intermediation but in different ways. Similar to crowdfunding, blockchain also creates new intermediaries, but the trust element inherent in blockchain is able to eliminate the need for intermediaries in some financial services (Weiyi Cai). Blockchain technologies provide new ways to assess risk and treat financial information, allow for easier participation of nonprofessional investors in entrepreneurial financing, provide greater liquidity, and reduce monitoring costs of investors, but can also lead to higher contagion risk due to greater connectedness through securitization (Block et al). Financing is by far the most important segment of the emerging fintech market, followed by payment, asset management, insurance, loyalty programs, risk management, exchanges, and regulatory technology (Haddad et al). The implementation of blockchain technology in the financial markets could provide investors with new options for managing the transparency of their operations and their trading intentions and this is among the reasons why many believe that blockchains would become a potential mainstream financial technology for the future (Jagtiania et al). Blockchain represents thus an innovation able to disrupt the way the global financial system works and change the nature of investment breaking the old paradigm of requiring trusted centralized parties (Weiyi Cai). Applied in the financial sector its application is expanding into settlement, remittance, securities and smart contracts and payments between banks based on a closed (private) distributed ledger. Access to venture capital is not equally available in every region of the world and investment opportunities strongly differ by geographic location (Haddad et al). Fintechs and blockchain might improve financial inclusion when traditional banks fail to fulfill this task, including approximately 3 billion of unbanked population, facilitating access to saving, loans, investments and payments (Jagtiania et al). One application of blockchain

based financing are ICOs that boomed in 2017. The token mechanism allows funders to create a secondary market for their investments, while conventional equity-based, lending-based or rewardbased contracts are essentially illiquid. ICOs have significant potential in funding “decentralized” cross-country teams of developers, favoring open innovation. Although some countries have banned ICOs, others are clearly signaling the “borders” that should not be trespassed and will probably move toward regulating token offerings to avoid fraudulent behaviors (Adhami et al). ICOs provide digital entrepreneurs with the opportunity to raise funding while avoiding costs of compliance and intermediaries (Huang et al).

ii. The implications of an unregulated market for investments for the raise of fintechs

Regulators have a role to play in encouraging the productive use of Fintech innovations. Regulatory policies and guidance involve a trade-off between protecting consumers and encouraging Fintech innovations and competition (Jagtiania et al). In this context governments play a major role in shaping the development of crowdfunding and fintech initiatives (Ahlstrom et al). Solving the difficulties in raising seed capital is gaining importance in the policy agenda of local, national, and international governmental institutions (Block et al). Besides public institutions, regtech companies play a major role impacting regulators and banks and start-ups are already challenging traditional banking models globally, resulting in wider banking access, cost cutting, expedience, efficacy but also security value. From the incumbents’ viewpoint, new entrants lack the regulatory-compliant IT security and regulatory certainty (Anagnostopoulos). RegTech with its enhanced analytics, real-time information and timely reporting provides the regulator with a unique opportunity to focus on the financial risks to deliver for financial stability. Both traditional financial institutions and fintech startups face regulatory challenges in capital requirements, anti-money laundering, and privacy and security. For traditional financial institutions, the cost to meet regulatory requirements and compete against fintech startups can be significant (Lee et al). Each business model carries one extra layer of complexity than the previous one and hence regulatory responses will have to be varied and applied on a case by-case basis (Anagnostopoulos). It is true that traditional financial institutions are subject to more rigorous regulation from government regulators. The looser regulatory requirements imposed on fintech startups allow them to provide more customized, inexpensive, and easy-to-access financial services to consumers than

traditional institutions. Many financial companies are seeking to acquire fintech firms because they can among improve business processes, solve complex IT problems, reduce cybersecurity risks, potentially lower regulatory expenses (Dranev et al).

Depending on the national economic development plans and economic policies, different governments provide different levels of regulation (Lee et al), but existing rules and institutional structures are becoming less capable to follow the rapid pace of change. In that manner, fintech's and regtech's combined dynamic is positioned way beyond any single industry's or regulator's domain (Anagnostopoulos).

iii. The globalization effect when it comes to investments and funding through blockchain

By 2025 10% of the world's GDP (currently about $100tn) may be on blockchain. There is a rapidly growing population of start-ups innovating across various segments of this highly dynamic industry. Three factors are shown to contribute to a rapid internationalization of blockchain start-ups: network effects, solving the chicken-and-egg problem and building an ecosystem around the evolving technology (Zalan). Blockchain start-ups internationalize literally at birth. Blockchain start-ups are solving the chicken-and-egg problem and reaching a global scale quickly in a novel way: rather than price subsidies and advertising as drivers of adoption, they foster user and developer engagement and monetization. Internet entrepreneurs in fact put an emphasis on growth and attracting a user base first and focus on revenues and profits later (Huang et al). Intermediation changed from traditional banks to shadow banks: non-depository institutions falling outside the scope of traditional banking regulation. This change has coincided with a shift away from "brick and mortar" originators to online intermediaries. This allows fintech lenders to charge higher rates, particularly among the lowest risk, least price sensitive and most time sensitive borrowers. Fintech lenders provide convenience rather than cost savings to borrowers (Buchak et al). ICOs take place more frequently in countries with developed financial systems, public equity markets, and advanced digital technologies. The availability of investment-based crowdfunding platforms is also positively associated with the emergence of ICOs, while debt and private equity markets do not provide similar effects. Countries with ICO-friendly regulations have more ICOs, whereas tax regimes are not clearly related to ICOs (Huang et al). A technical white paper may be an effective signal in ICOs in contrast to patents. Interestingly, both patents and

technical white papers constitute a detailed description of a venture's technological efforts. Research in crowdfunding finds that ventures that are able to communicate as precisely as possible raise more funding. This may be reflected in technical language, but it may also lie in being able to describe a highly technical problem in a very nontechnical and understandable way (Fisch), nevertheless everyone has access to the technical description and would be able to invest on the project, making it globally available.

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4.4.4. Summary - Table 1

Stream	Authors	Article	Research Question	Data	Research method	Findings
i	*Ahlstrom, Cumming D.J., Vismara S.*	New methods of entreprene urial firm financing: Fintech, crowdfundi ng and corporate governanc e implication s	How do equity crowdfunded firms perform relative to firms that raised capital in other, traditional, ways? What are the governance causes and consequence?	Four papers investigating the role of crowdfundin g and fintech for corporate financing purposes	50 manuscripts that dealt with questions around five key themes introduced in the call for papers. CGIR oversaw the process and participated in decisions on all rounds for all papers. Finally, four papers were selected	The access to fresh capital that was locked before improved the chances of success for those firms that manage to avoid governance issues, which are the major reason of failure after being financed through crowdfunding. Governments play a major role through legal institutions in shaping the development of crowdfunding and fintech initiatives.
i	Joern H. Block & Massimo G. Colombo & Douglas J. Cumming & Silvio Vismara	New players in entreprene urial finance and why they are there	Give orientation about recent developments in entrepreneurial finance. Following this and discuss the factors explaining the emergence of the new players and group them into supply- and demand-side factors.	Academic articles and papers researching the topic of corporate financing	Introduction and description of the new players and compares them along the four dimensions: debt or equity, investment goal, investment approach, and investment target.	There will be an interaction between the new players or instruments and the established forms of entrepreneurial financing such as VC or BA financing. New financing instruments are regarded as complements rather than substitutes
i	Cynthia Weiyi Cai	Disruption of financial intermediati on by FinTech: a review on crowdfundi ng and blockchain	Provide a better understanding of FinTech by identifying the development of knowledge and gaps in relevant finance research, in particular crowdfunding and blockchain applications	Systematic review of influential publications among 402 papers published between 2010 and 2018,	Bibliographic mapping and data collection and analysis follow the methodological steps outlined by Janssen et al. (2006) and Janssen (2007)	Crowdfunding and blockchain can be regarded as two innovations that may disrupt traditional financial intermediation but in different ways; Crowdfunding act as new intermediaries, while blockchain allows to eliminate intermediaries in some financial areas
i	Julapa Jagtiania, Kose Johnb	Fintech: The Impact on	Fintech’s potential disruption and its impact	Selected papers from the	Analysis of the selected papers	Both traditional institutions and the Fintech platforms have

		Consumers and Regulatory Responses	on financial landscapes and financial stability. Lending and its role in enhancing competition, the type of risks that emerge in the new financial environment. Blockchain and digital currencies	conference The Federal Reserve Bank of Philadelphia and New York University Stern School of Business		been competing and have benefited from their partnerships. The new financial landscapes have a potential to connect billions of unbanked and underserved consumers to the financial systems. Fintech rules should reach the right balance between providing consumer protection and fostering innovation
i	Christian Haddad & Lars Hornuf	The emergence of the global fintech market: economic and technological determinants	Understand the determinants that enhance the rise of fintech startups in countries. Why do some countries have more startups intended to change the financial industry through innovative services and digitalization than others	The data source for our dependent variable is the CrunchBase database, which contains detailed information on fintech startup formations and their financing.	Investigation of several economic and general technological determinants that have encouraged fintech startup formations in 55 countries. Startups are divided in 6 different categories according to their focus.	Countries witness more fintech startup formations when the economy is well-developed and venture capital is readily available. Furthermore, the number of secure Internet servers, mobile telephone subscriptions, and the available labor force has a positive impact on the development of this new market segment. Finally, the more difficult it is for companies to access loans, the higher is the number of fintech startups in a country.
i	Saman Adhami, Giancarlo Giudicib, Stefano Martinazzi	Why do businesses go crypto? An empirical analysis of initial coin offerings	Understand the determinants that make a fundraising campaign more successful than others.	Lists published by the main ICO information providers on the web	Analysis of determinants of the success of token offerings by considering a sample of 253 campaigns	The probability of an ICO's success is higher if the code source is available, when a token presale is organized, and when tokens allow contributors to access a specific service
ii	Ioannis Anagnostopoulos	Fintech and regtech: Impact on	This study examines the implications for financial institutions, and regulation	Academic literature as well as insights from industry sources, action	Action research, since emerging, unstructured, or integrative issues through direct participation in	Banks with a fresh core and open and flexible digital architecture will be better positioned to

		regulators and banks	especially when technology poses a challenge to the global banking and regulatory system.	research and other publicly available commentaries.	think-tanks and roundtable discussions	capitalise on the advantages and prosper. However, various key barriers restrain business relations between them. From the incumbents' viewpoint, new entrants lack the regulatory-compliant IT security and regulatory certainty
ii	In Lee, Yong Jae Shin	Fintech: Ecosystem, business models, investment decisions, and challenges	This article illustrates the use of real options for fintech investment decisions. Finally, technical and managerial challenges for both fintech startups and traditional financial institutions are discussed	Academic articles and papers	Presented five elements of the Fintech ecosystem and discussed six fintech business models. Finally, six challenges facing the fintech sector were discussed	While fintech is generally considered a threat to traditional financial firms, it also provides ample opportunities for these firms to gain a competitive advantage over competitors. Most major financial firms have begun taking fintech seriously and are developing strategies to compete, coexist, and collaborate with fintech startups.
ii	Yury Dranev, Ksenia Frolova, Elena Ochirova	The impact of fintech M&A on stock returns	This paper contributes to the existing literature by investigating the post-acquisition performance of the acquirer firms measured by abnormal returns	The information about M&A transactions in this study was collected from the Zephyr (Bureau Van Dijk) database.	Event study methodology	Significant positive average abnormal return after acquisition of fintech companies in the short-term and negative average abnormal return in the long-term using event study methodology
iii	Tatiana Zalan	Born global on blockchain	The purpose of this paper is to alert international business (IB) and international entrepreneurship (IE) researchers of a new phenomenon and novel research opportunities arising as a result of digital innovations brought by the "blockchain".	Author's research	viewpoint based on the author's ongoing research on blockchain and fintech and reflections on the born global literature	The author argues for establishing a theoretical link between the born global literature and the literature on the economics of information goods and platform economics to explain the pace of international growth in

						the context of blockchain start-ups.
iii	Greg Buchak, Gregor Matvos, Tomasz Piskorski, Amit Seru	Fintech, regulatory arbitrage, and the rise of shadow banks	Study how two forces, regulatory differences and technological advantages, contributed to the growth among online “fintech” lenders	Author’s research and existing papers	Test two broad hypotheses to explain the decline in traditional banking: increased regulatory burden on traditional banks and disruptive technology	The paper shows two important aspects of this transformation: the rise of shadow bank lenders on one hand and the rise of fintech lenders on the other. Regulation accounts for roughly 60% of shadow bank growth, while technology accounts for roughly 30%
iii	Winifred Huang & Michele Meoli & Silvio Vismara	The geography of initial coin offerings	Understand the reason of the emergence of ICOs across countries	Population of 915 ICOs issued in 187 countries between January 2017 and March 2018	Negative binomial regressions with robust standard errors to conduct our country-level analyses. In order to test four hypotheses	ICOs take place more frequently in countries with developed financial systems, public equity markets, and advanced digital technologies
iii	Christian Fisch	Initial coin offerings (ICOs) to finance new ventures	What factors determine the amount of funding raised in ICOs?	Data relative to 423 ICOs	Assesses statistically the determinants of the amount raised in 423 ICOs.	Technical white papers and high-quality source codes increase the amount raised, while patents are not associated with increased amounts of funding.

CHAPTER 5 - Delphi Methodology

The Delphi method, name taken from the Greek oracle Delphos, is a structured technology forecasting method, developed as a systematic and interactive method of prediction, which is based on a panel of experts and is carried out through a series of iterations, called rounds. It is a prospective technique used to obtain essentially qualitative but relatively accurate information about the future, in the case of this research, about the future of blockchain technology. Its objective is the achievement of consensus based on the discussion among experts through an interactive process. Its operation is based on the preparation of a questionnaire that each expert must answer. Once the overall results have been analyzed, another questionnaire will be asked once again by the same experts, after informing them of the results obtained in the previous consultation. The process can be repeated several times until reaching a certain level of consensus. Finally, the person responsible for the study, the facilitator, will draw up her conclusions based on the statistical exploitation of the data obtained.

The Delphi forecasting method uses judgments from experts in technology or social processes considering the responses to a questionnaire to examine the probable orientations of the development of specific technologies or different processes of social change. The summary of expert judgments (in the forms of quantitative assessments and written comments) are provided as feedback to the same experts as parts of a next round of questionnaire. Next, experts re-evaluate their opinions in light of this information, and a group consensus tends to emerge. Technological forecasting, including Delphi forecasting, is a form of logical analysis that leads to conclusions about the future of technological attributes (Scott, 2001). The Delphi technique is based on firm concepts to draw conclusions with supported arguments.

The Delphi method is principally based on:

- the anonymity of the participants;
- repeatability and controlled feedback;
- the group's response in statistical form.

Before starting a Delphi method, a series of previous tasks are performed, such as:

- Delimit the context and time horizon in which you want to make the forecast on the subject under study;
- Select the panel of experts and get their commitment of collaboration. The people who are chosen must not only be very knowledgeable about the subject on which the study is carried out, but they must present a plurality in their approaches. This plurality must avoid the appearance of biases in the information available in the panel;
- Explain to the experts what the method consists of. This is intended to obtain reliable forecasts, because experts will know at all times what is the objective of each of the processes required by the methodology.

The name Delphi is derived from the oracle of Delphi, although the authors of the method were not happy with the connotations of the name, which could undoubtedly be linked to the world of the occult. The Delphi method assumes that judgments of a group are more valid than individual judgments.

The Delphi method was developed at the beginning of the Cold War to predict the impact of technology on the conflict. In 1944, General Henry H. Arnold ordered that a report had to be prepared for the United States Army Air Forces about the technologies that the army could develop in the future.

Different approaches were attempted, but it soon became apparent that traditional methods of technological prediction, such as the theoretical approach, quantitative models or extrapolation of trends, were deficient in areas where scientific laws had not yet been established. To overcome these shortcomings, the RAND Project (Olaf Helmer, Norman Dalkey and Nicholas Rescher) was started. Several experts gave their opinion about the probability, frequency and intensity of possible enemy attacks. Other experts offered the corresponding feedback. This process was repeated several times until a consensus was reached.

Due to the absence of empirical evidences and literature as well as the immature status of blockchain based applications, this research employed a Delphi study to reach experts knowledge and expertise and insights about the future of the blockchain technology. Delphi study gives effective insights thanks to the combination between deductive research and more qualitative data in such a way that a more pragmatic

instrumentalization is provided. This can enable methodological triangulation (Yin, 2003), improve validity (de Vos, 1998) and increase the contextual understanding of phenomena (Jick, 1979). Around blockchain technology the world is divided between skeptics who believe the technology has a lot of points of failure and is still too immature to become a paradigm in the near future, and blockchain enthusiasts who instead believe that this radical innovation will disrupt many industries and completely change business models and people's behaviors, like internet did during the 90s.

This research aims to fill the gap between the two points of view, bringing experts, involved and working now on blockchain projects, to provide their knowledge through interviews and subsequent questionnaires, focusing on the possible changes that the blockchain will bring by 2030.

After all data and insights are gathered from the panel of experts, a probability-impact map will show the likelihood that a scenario will arise and the impact it will have on the economic-industrial context. Furthermore, the research gives insights about the impacts that the new technology will have on business models, the industries that will need the most urgent and radical change with a focus on financial institutions and the rise of Fintech startups.

Many different variants of the Delphi methodology, from its first application during the 1950s, has been developed according to the needs and goals of each research. For the purpose of this dissertation it was decided to follow the four-steps procedure suggested by Von Der Gracht and Darkow (Gracht et al. 2010).

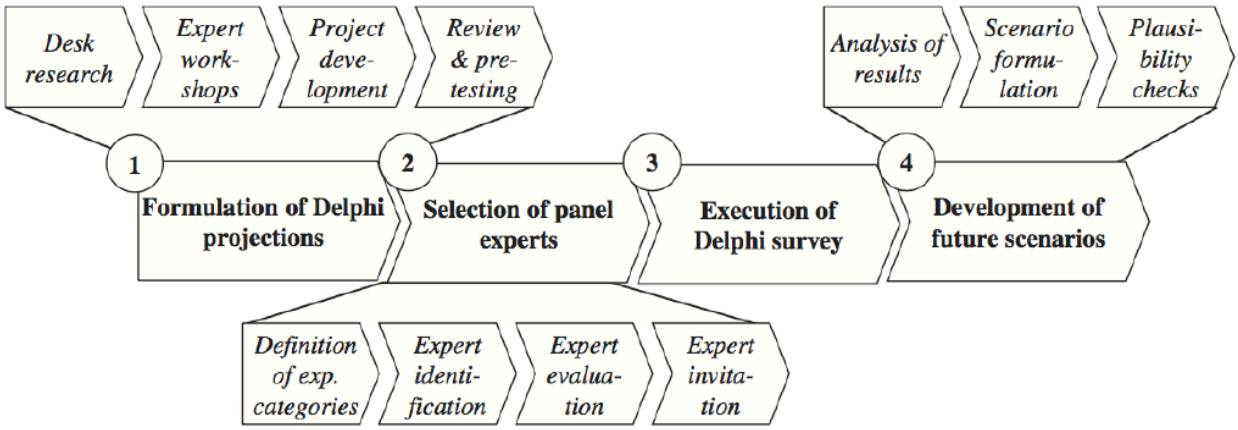


FIGURE 18 - DELPHI PROCEDURE

This procedure was first presented by Gracht and Darkow in 2010 in their study “Scenarios for the logistics services industry: A Delphi-based analysis for 2025", becoming a widely accepted and approved variant of the Delphi approach. The first step of the method requires the facilitator, or the one who is in charge and manages the entire study, to develop and envisage projections and possible scenarios that might arise through the adoption of the technology. This phase requires the researcher to deeply understand the technology analysing existing literature (also called desk research), attending courses and workshops and conducting a number of face-to-face interviews with blockchain experts. Once the insights are gathered, the results are synthetized in future scenarios that will help develop the future questionnaires.

The second step consists in presenting the study to the panel of experts selected and who will take part in the first round of questionnaires. The main challenge during this phase is to select an appropriate panel of experts and maintain their commitment and response rate.

The third step consists in a statistical and quantitative analysis of the answers received and select the second-round scenarios that experts will need to evaluate again.

Through the analysis of the second round of answers, updated scenarios are developed adding to the projections the qualitative and quantitative provided by the research.

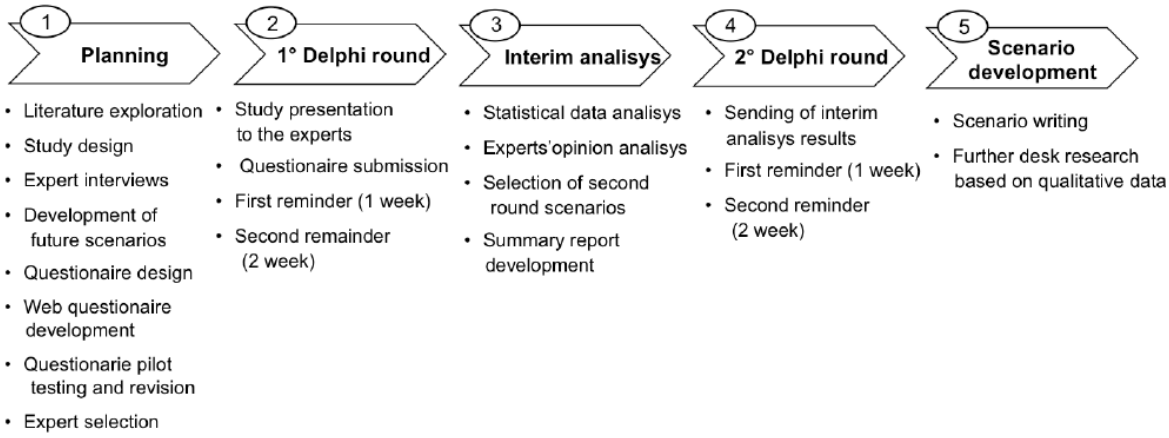


FIGURE 19 - DELPHI STEPS

5.1. Formulation of Delphi Projections

The formulation of the projections represents a key aspect of the methodology and requires a particular attention and effort. In this phase indeed, the projections that will be later on tested by the panel of expert are generated and thus they must be carefully selected and presented in a clear and comprehensible manner. Vagueness and inaccuracy might generate confusion in experts leading to less meaningful results. To avoid this situation, scenarios were developed with a cross-fertilization activity including literature review, interviews with experts and participation to workshop and conferences.

The analysis of the literature on blockchain technologies allowed to understand better and deeper what will be the industries and businesses that will be impacted by the technology and the level of innovation reached by its different use cases. The literature review also had a positive impact in structuring the expert face-to-face interviews as well as the participation to the conferences allowed me to personally reach the experts that participated either to the interview phase, either in the two rounds survey.

The analysis of the literature has been carried out focusing on the European current situation and the interviews were done with experts that are now working on projects for companies or organizations in major European countries. At the beginning of the research it was chosen to focus on future scenarios for financial services and in particular on corporate financing and how blockchain based system represent a new and potentially disruptive source to access to capital for start-ups, SMEs and incumbents. As time

horizon was chosen the year 2030, since a period of eleven years was considered appropriate for the generation of the scenarios. A lower forecasting period could result unhelpful, since such projections are more common for other types of researching methodologies. For a Delphi method, such a time span is recommended, since a superior one would have become unmanageable to provide relevant advice for strategic development. These choices were made in order to provide more specific results that will be useful for the actors that are interested in exploring and implementing the technology as well as a contribution to the existing literature, since similar researches have been carried out, but with different characteristics or objectives. Furthermore, analysing the European situation is furthermore of particular interest since even though a late comer, compared to China and the US, is now rapidly catching up fostering innovation and R&D activities and making efforts to regulate the coming of this potential paradigm shift.

5.1.1. Interviews with Experts

Twelve blockchain experts have been interviewed among academics, start-ups, consultancy firms, established and traditional banks and legal institutions. In particular:

- 3 Academics
- 3 Start-ups
- 2 Consultancy firms
- 2 Traditional banks
- 1 Non-profit organization
- 1 Lawyer

The selection of the experts has been made in order to get different point of views and a high level of expertise, as provided by the Delphi method guidelines, and not to have a various sample. The choice has also been made considering the interest of the expert in the dissertation and in knowing the final results. This allowed to conduct interviews that took between thirty and forty-five minutes on average, according to the interviewee availability. The facilitator conducted the interviews without following a specific and standard method but chose the questions and the structure of the interviews according to each expert's area of expertise. Each single interview was tailored for each of the participant giving guidelines and reflection tips to encourage discussion, but a certain

degree of freedom was given to the expert to allow her contribution and to gain some insights that helped the facilitator in the decision of the future scenarios and to make new scenarios emerge. Common aspects were discussed in all interviews generating redundancy and repetition of already emerged scenarios, such as ICOs, business model evolution, security and utility tokens, differences between DLTs and public blockchain and legal issues. This is one of the reasons why twelve interviews were considered sufficient for the purposes of the dissertation. Moreover, enough and relevant scenarios already emerged for the facilitator to start editing the questionnaire.

The common idea shared by all experts, is that decentralized systems will have real benefits in the future. The standard that will take off is not yet there and its definition is strongly correlated and subject to regulations and incentives made by governments. Companies are now rushing to understand the technology because they fear of missing out an opportunity, but most of them haven't found a practical use case with a positive ROI yet. The implementation is still too costly due to the lack of experts and the specific knowledge required to develop reliable platforms, thus SMEs find lot of difficulties to gain expertise and only incumbents can allocate important amounts for R&D activities. An outcome that arose during the interviews is the difference vision of the technology between start-uppers and bankers and consultants working for long established companies or incumbents. In general, the formers give much more importance to the development of public blockchains, such as the Bitcoin one, resulting in more disruptive scenarios and visions, whereas the latter group is more conservative and considers DLTs as the future and more reliable path to be followed.

Regarding ICOs and more in general corporate financing, different opinions have been discussed. Some experts consider ICOs a bubble that exploded and that will slowly disappear, while others positively consider their potential and even though the hype reached in 2017 will not strike again, decentralized systems to access funds will be developed and improved in the near future disrupting the traditional venture capital industry. Face-to-face interviews provided the facilitator with incredible insights about the strategic initiatives of companies in Europe, the difficulties they are encountering and their hopes and visions for the futures, avoiding speculation that might be found in online articles and reports about business initiatives.

To have a full view of the outcomes of the interviews, a detailed analysis of each interview is provided in Appendix A of Chapter 7. There are no hard and fast rules regarding the choice of the number of experts that should be interviewed. According to *Harold A. Linstone,* author of the book *The Delphi Method: Techniques and Applications,* a suitable minimum panel size is seven, but panel sizes have ranged from 4 to 3000. It seems, therefore, that the decision about panel size is empirical and pragmatic, taking into consideration factors such as time and expense. In this particular case a panel of 13 experts has been considered sufficient in order to avoid redundancy in responses that was noticed already in the last interviews. The novelty and that more interviews would have brought, would have not brought to the definition of new scenarios.

5.1.2. Workshops

The facilitator participated to conferences and workshops during which experts working with the technology were invited and presented the projects they were working on, as well as explained in deep some aspects of the technology and its future implications. Participating to these events allowed the facilitator to strengthen his knowledge about blockchain and have a broader view of its implications in different fields and industries.

The first event was held in Milan and twenty-seven speakers contributed to it, varying from startups, consultancy firms and incumbents. The event, besides providing many insights for the development of future scenarios, also allowed the facilitator to meet many experts that subsequently participated to the survey round of the methodology. The workshop provided different views about the technology thanks to round tables in which experts tried to defend their point of view in a constructive manner and eventually tried to reach a consensus. As already emerged in the interview phase, incumbents were more in favour of DLTs, while startups were defending more and investing on public blockchains such as Bitcoin.

A second event attended by the facilitator was instead organized in Paris by a multinational technology consultancy firm. The facilitator had the opportunity to participate to the event after winning a student contest organized by the company. The event treated all new technological trends that are the core business of the company, among them, blockchain engages a large share. Being the annual event of the company senior and C-level partners held speeches about the projects they were responsible of. The facilitator

focused in attending those related to blockchain technology. The participation to the keynote speeches fostered reflections for the purposes of the dissertation and as in the previous one, some participants agreed to participate to the various phases of the research. A general outcome of the conferences attended is that there is still a strong hype around the technology and different paths can be undertaken, but being the majority of the clients of the firm incumbents, most of the projects were DLTs or related to the management of consortia, which led to the conclusion that private blockchain systems will take off faster than public blockchains, due to major investments of big companies that can allocate a lot of capital to the projects. The facilitator participated to a third big event in Paris, the *Community Blockchain Week*, a blockchain tech-focused initiative organized voluntarily by people really engaged into the technology and with the will and vision to spread the knowledge about it to citizens. The event gathered all the brightest minds and latest improvements with the goal to bring blockchain communities together and foster communication within and without crypto communities. The facilitator had the opportunity to participate to various workshops and speeches during the week, allowing him to deep dive into some aspects of the technology as well as to meet some very knowledgeable experts of various fields, of which some agreed in participating to the research. The event helped the facilitator to understand not only how the technology is evolving and the projects that are right now more promising, but also enabled to see how the community engages itself to spread the knowledge in order to generate more and more interest around it. Many founders of startups participated as speakers, and contrary to the previous event, most of them worked on public blockchain.

5.1.3. Desk Research

Besides the literature review presented in Chapter II, the generated projections in this exploratory phase were noted and analysed. This process allowed to identify 76 projections that were of great help as a starting point of reflection during the expert face-to-face interviews.

After screening the relevant articles to gain an overview of emerging trends, a first filtering of the identified 76 projections has been made in order to dismiss redundant or incomplete projections, and to keep only the most complete and varied ones. This process allowed to reduce the number of projections to 33 and to 20 after the review of two experts in

order to edit a feasible questionnaire. All the projections are reported in Chapter 7 at the end of the dissertation (Appendix B).

Being the literature review more general and touching different topics and industries, it allowed to gain a comprehensive view of all the potential scenarios of the technology. This was a very useful phase of the research that helped completing the scenarios, since the face-to-face interviews that instead were focused on the area of expertise of the expert, who might have been biased, forgetting potential disruptive trends and evolutions.

Analysing consulting companies reports offered a broader vision of future production scenarios, thanks to the more strategic than technical background, and their experience in several areas. This allowed introducing new projections, which had never been previously discussed in the interviews and of which no academic research was still available. Following in this chapter are presented the major findings of the literature review. Blockchain technology and related decentralized systems have become in the past few years a hot topic and researchers stepped in to better analyse its potential and possible applications. The following chapter examines papers and academic articles that focused on studying the disruptive potential of blockchain in a company's organization and structure as well as the benefits that this technology could bring in terms of corporate financing. A first application that will change how companies are managing their internal audit is the use of a decentralized system to keep track of all the transactions and update the financial statements. Auditors will be involved in auditing the technology associated with blockchains, as well as retrieving transactions from them. Moreover, because the software needed to maintain transactions in a blockchain is complex, auditors must provide assurance related to the system's control environment. Thus, auditors must develop new skills and competencies in order to be able to trace transactions from blockchains to balance sheets and income statements. Of course, in such a scenario tools of data analytics and artificial intelligence would be of valuable help in order to avoid fraud recognizing patterns across the entire transaction population. Such a radical change in auditing activities will affect the degree of responsibilities of the employee's roles. Internal auditors will be responsible for recommending controls associated with organizational processes that use blockchains, including the acquisition, protection, delivery, and enhancement of the information assets stored within them (Lee, Fiedler and Mautz, 2018). Not only security would be improved by implementing the blockchain technology but also costs and the duration of processes would be reduced (Haiss Peter,

Andreas Moser). For example, blockchain could save financial institutions at least $20 billion annually in settlement, regulatory, and cross-border payments costs (Kurt Fanning et al.). With the raising of the Internet of Things and thus the exponentially increasing number of interconnected devices that are now being released and adopted a reliable system to allow the exchange of that rapidly and safely is mandatory. By now, blockchain technology represents the only foreseeable solution that will solve the problems of scalability, privacy and reliability related to the IoT paradigm. IoT in fact can join forces with blockchain in many scenarios, improving the efficiency of many operations inside and outside a company or an ecosystem. The adoption of IoT solutions for a confined purpose and environment could benefit indirectly other actors and stakeholders. Almost all traceability applications can benefit from the inclusion of IoT devices, for instance, sensors that are attached to the product to be traced can provide information during its distribution. Blockchain could be a powerful candidate to make the smart city concept a reality. The concept of the smart city is based on smart IoT devices that can work autonomously. Blockchain can increase the autonomy of devices since it eases interaction and coordination by providing a distributed open ledger where devices can query trusted information with reliability (Reyna et al., 2018). Another important cooperation between the IoT world and blockchain relies on smart contracts. Smart contracts could possibly connect devices that will autonomously be in charge of ordering, delivery and payment activities developing their own contracts and signing digitally. With all the experience being safely traced on a blockchain-based architecture (Reyna et al., 2018).

Regarding the possibilities that blockchain brings in terms of corporate financing and access to capital, there are many possible ways that could be undertaken. Many means are being experimented, but as for many breakthrough technologies, is often a matter of laws and regulations rather than technological barriers to slower down the pace of innovation (Cantamessa and Montagna, 2015). In the newly proposed blockchain embedded credit system, SMEs with low-risk and high-quality could display their credibility and risk class through information distribution. They are more likely to access bank loans even if they are not able to provide collateral (Rui Wang, Zhangxi Lin, Hang Luo). In the current centralized system, SMEs and those companies that are willing to access to capital, suffer of information asymmetry in which one of the parties involved has more or better information than the other. Through decentralized consensus and

information distribution mong all participants information asymmetry and credit rationing problems could be alleviated. Moreover, it would be possible to generate risk sharing mechanisms involving governments, banks and firms in a risk pooling innovative system for the blockchain lending and borrowing. Of course, the tamper-proof algorithmic executions characteristics of the blockchain will guarantee the reliability of all this new and innovative processes (Rui Wang, Zhangxi Lin, Hang Luo). Among others, the benefit of democratizing and enabling to raise funds directly from investors across the globe, fosters entrepreneurial activities, since entrepreneurs will have more ways and means to raise funds and engage stakeholders. On the other side this system would also allow investors to invest on early stage projects that are normally reserved to venture capital firms (Chen). Drawbacks arise when allowing a complete free and accessible market for investments, since regulations are still referring to a closed and defined market. When suddenly people are allowed to raise capital and invest on scratch projects problems and fraud have occurred. In 2017 many ICOs that raised incredibly huge amount of money turned out to be scam, since no rules were needed to be followed. The future of ICOs is fuzzy and is unclear whether they will still exist in a regulated manner, or if other forms of financing will be developed. But among the benefits of democratic fundraising and investments, tokens could be also used for community building, so that platforms will be able to reward early adopters with tokens compensating the lack of network effects due to a low initial number of users. Another possible use case in which tokens could be a useful means to reward the community is the financing of open-source projects. Open-source projects can fund their continued development through token sales, by sharing their success with core developers and not by asking for donations. ICOs favor open-source project development and decentralized business, generating a built-in customer base and positive network effect. If ICOs will keep being used and become a dominant design as financial instrument the availability and quality of the information regarding the project, such as a clear and transparent white paper and open source code, related to the investment, will positively affects the probability of a project's success (Saman et al.). However, it is not exactly clear how blockchain-based instruments are going to be used and implemented and what will be their exact characteristics, but is quite certain that traditional venture investments will face major radical and disruptive changes (Chen). It is important to keep in mind that many are predictions that often have not yet found a real application. To make clearer the idea of which is the actual potential of blockchain, the Gartner Hype Cycle methodology could be used. It provides a view of technologies status

through a source of insight about their maturity and level of adoption. It tries to show how these insights are potentially relevant to solve real business problems and to exploit new opportunities. In Figure XX is presented the last release of the Gartner's 3D printing hype cycle and which are the current applications that have exceeded the peak of inflates expectations. It underlines how applications that are moving along the slope of enlightenment have previously passed through a high hype phase, which has been resized with time and with new product generations. At the end of the slope, there are a group of technologies that are by now become mainstream (Cantamessa and Montagna, 2015). Gartner's latest technology hype cycle (Figure 20) puts blockchain past the peak of expectations and close to entering the trough of disillusionment. They estimate a 5-10 year timescale before it enters the plateau of productivity, or mainstream.

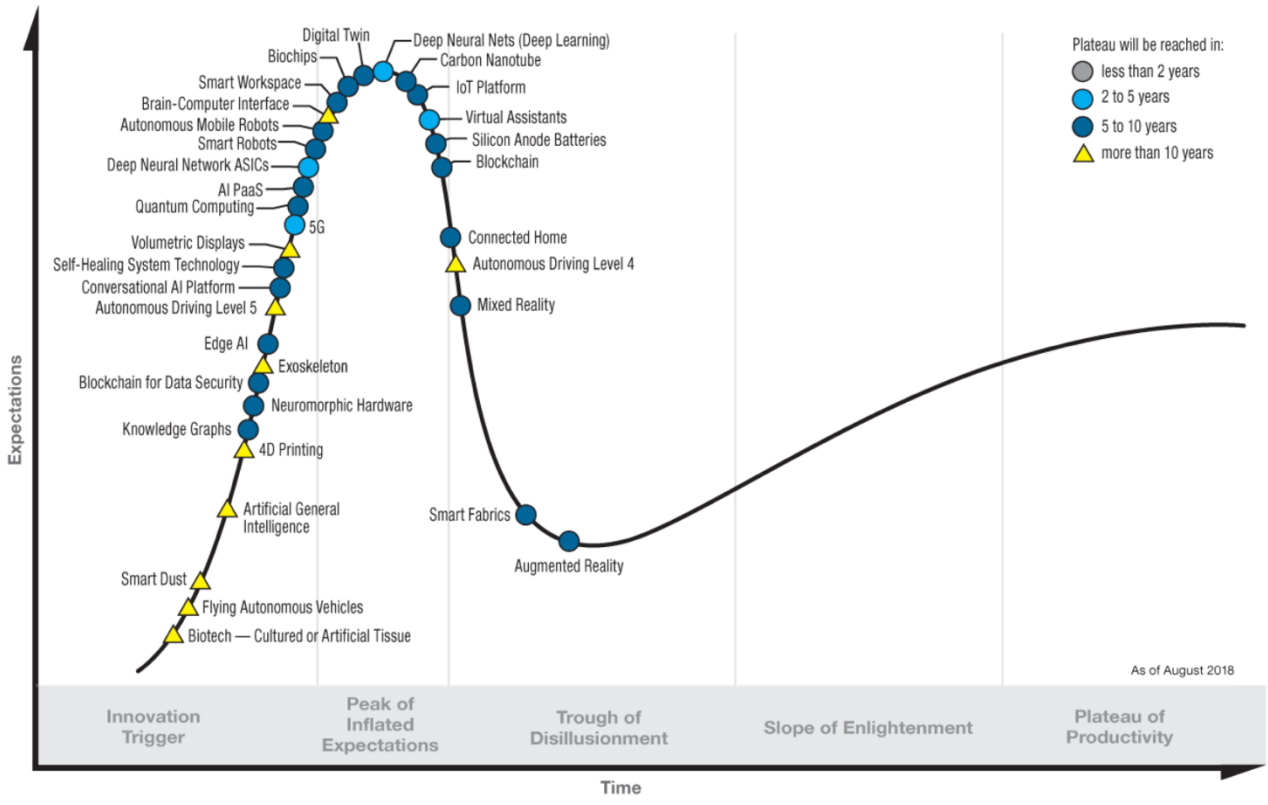


FIGURE 20 - GARTNER HYPE CYCLE FOR EMERGING TECHNOLOGIES, 2018

The hype effect is important to be considered, since stakeholders involved are not willing to invest in a potentially hyped technology. For example, banks and most conventional institutions and incumbents are investigating, but don´t know much about it yet. Developments to date suggest that the blockchain technology bears promise but that

there is still a long way to go for implementation. There are some advantages perceives, such as the reduction in cost and duration of processes and procedures, but a big perceived disadvantage is the lack of a legal framework and the slow pace at which governments and legal institutions are taking actions to foster the innovation. Furthermore most of the blockchains right now available need to solve various technological, operational and regulatory challenges in terms of scalability, interoperability, standards and governance, personal data protection and digital identity management to ensure fair and secure access to data stored on a distributed ledger, all these issues inevitably slow down the evolution and the adoption of existing solutions (Haiss Peter, Andreas Moser). Either internal or external, organizational changes will lead to the disappearance of long-standing business professions and businesses, that will be forced to adapt themselves to stay competitive enforcing structural changes and training resources on new skills and knowledge (Kurt Fanning et al.)

Regarding financial services, blockchain represents a possible solution to generate and transform financial instruments in a digital and decentralized way. Through blockchain-based systems it would be possible to issue and transfer equity shares of closely held companies on the exchange's private marketplace. This will allow to replace the current paper certificates system, with a lowering of cost and a gain in speed of having the initial public offering. Using a Blockchain the accounting entries between two trading partners can easily be compared while maintaining data privacy, this could significantly reduce the reliance on auditors for testing financial transactions. Smart contracts using the blockchain make contracts possible where the parties involved do not have to trust each other. This may change the process of taking out a loan massively. They could make loan payments safer and faster, because they take action when conditions are met and therefore reduce the risk of errors (Haiss Peter, Andreas Moser). But implications and use cases are not only being developed by financial institutions, in the healthcare industry for example, it is of key importance to store patient data securely and accurately. The public sector in general will become potentially a great user of blockchain since several municipalities are looking at blockchains for recoding property transactions or examining using blockchains for tamperproof voting records and vehicle registries (Kurt Fanning et al.). All the possibilities of having an easier access to capital will stimulate entrepreneurship activities. Entrepreneurs will promote and adopt new ways to raise funds leading to a major engagement of stakeholders. This will translate also to a higher

degree of democratization of the access to financial capital across the world, but also means giving investors opportunities to invest in early stage projects across the globe (Chen, 2018). According to Chen, the democratization brought by blockchain regarding investments will benefit the creation of communities, i.e. platforms that are able to reward early adopters with tokens, compensating for the lack of network effects. Also, open-source projects will benefit from new forms of capital accessibility, by being able to fund their continued development through token sales. They can share their success with core developers through tokens, not by asking for donations, but by issuing blockchain tokens.

Blockchain tokens will thus disrupt traditional venture investments (Chen, 2018) and has the potential to disrupt the way global financial system works changing completely the nature of investments (Weiyi Cai, 2018). Granting access to alternative portfolios of investments and financial services that traditional financial system is unable to provide, is a key factor that will lead to rapid adoption of the blockchain throughout many industries (Larios-Hernández). Since blockchain technology will serve to solve problems related to lack of trust, transaction costs and fraud, payment-clearing systems and bank credit information are a perfect scenario where to apply blockchains and start discovering their potential (Guo and Liang, 2016). Linked to the ability to solve the trust issues, blockchain could easily manage the registration of shares and the management of funds that are typically collected through crowdsourcing activities. This will facilitate corporate governance enabling shareholders to exercise control over a company that they have funded (Zhu and Zhou, 2016). A major advantage of crowdfunding is that requires fewer regulations and thus, it leads to have lower transaction costs associated (Weiyi Cai, 2018).

In general, blockchains that are used in the financial sector are expanding into settlement, remittance, securities and smart contracts and payments between banks based on a closed (private) distributed ledger (Yoo, 2017). Besides all the opportunities blockchain will need to face many challenges in order to achieve broader adoption and see large implementation (Mills et al., 2017). Thus, blockchain will influence and affect deeply the nature of companies, from funding to the entire management structure. New business models able to generate value will raise, varying from, developing, marketing, accounting and incentivizing people and employees. New forms of organizations will thus emerge benefiting from the cost reductions brought by blockchains, such as outsourcing overhead costs, crowdsourcing innovation, and eliminating middle managers and other

intermediaries (Tapscott and Tapscott, 2017). Firstly, organizations willing to generate business models built on social and solidarity (Scott et al., 2017). This view is also share by other experts who believe that blockchain technology will be able to disrupt existing business models in three crucial ways: through the authentication of traded goods, the disintermediation ability and by lowering transaction costs (Nowinski and Kozma, 2017). Blockchains presents issues, such as scalability due to the low efficiency now present in the infrastructure and many experts agree that these problems cannot be overcome, without sacrificing either decentralisation or security (Casey et al.). However, the presence of network effects seems to suggest that the benefits associated to blockchain applications will increase as the number of users increases (Casey et al.).

5.1.4. Delphi Projections

The formulation of the projections represents the most delicate part of the research since through the first and the second round of surveys will influence the whole study. So, a detailed analysis was carried out in order to avoid mistakes and confusion in order to approve the final scenarios to be evaluated.

In order to facilitate the respondents filling the questionnaire and to avoid any kind of ambiguity, an introduction explaining the meaning of the terminology used in the questionnaire was presented before starting the survey. In particular was important to define the difference between private blockchain, public blockchain and decentralized ledger technologies, since in the community there's still a lot of confusion regarding their meaning. The facilitator with the help of two experts, decided that for the purpose of the research it was not necessary to specify the type of blockchain that will lead to the development of a scenario, thus in the introductory disclaimer it was specified that the term *blockchain-based systems* or *blockchain-based technology* indicated DLTs, public and private blockchains. If in a scenario a particular type of blockchain was to be evaluated, it was specified in that particular section. This solution helped respondents to focus on the possible scenarios that will evolve rather than in the nuances of the technologies that will foster and make it happen. A monitoring team formed by an expert that participated to the face-to-face interviews phase and an academic finance professor approved this solution. The two experts also validated the contents of the developed scenarios to ensure that the facilitator's technical shortcomings could have affected the

research. A final sorting of the identified scenarios was carried out, what led to the development of the final 20 scenarios that were included in the survey. The number of elements in each scenario was minimized in order to avoid any misunderstandings, since too long statements usually result in little agreement since there are too many elements to assimilate into a single interpretation.

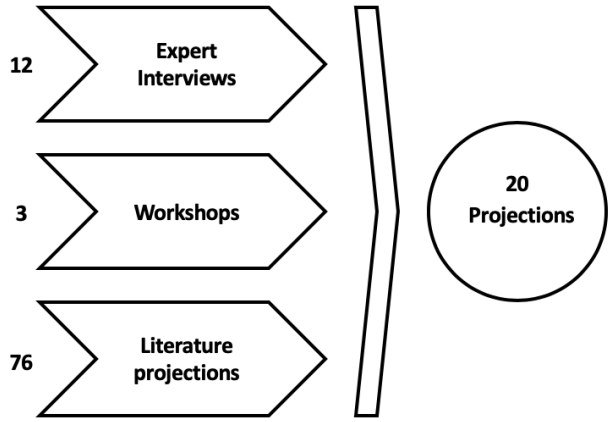


FIGURE 21 - FORMULATION OF DELPHI PROJECTIONS

The developed scenarios were broken down into six macro categories (the same as proposed by Gracht and Darkow in 2010) to guarantee a more complete and systemic view of how the blockchain ecosystem and community can change and shape the future.

TABELLA 2 - BLOCKCHAIN TESTED FUTURE PROJECTIONS

No.	*Projections*
	Socio Cultural
1	By 2030 in the European Union, most people and companies will have a degree of knowledge about what a blockchain-based system is and how does it work
2	By 2030, the European Union will be a leader hub and an example for companies working with blockchain-based technologies, applications and usage
	Policy and Regulations
3	By 2030 in the European Union, blockchain-based technologies will be widely used in order to increase security regarding transactions and data management as well as to reduce costs and duration of processes
4	By 2030 in the European Union, challenges in terms of standards and governance, personal data protection and digital identity management will be solved in order to ensure fair and secure access to data stored on blockchain-based technology
5	By 2030, regulations and directives made by the the European Union commission will foster the implementation, innovation and development of blockchain-based technologies and solutions
	Economic
6	By 2030 in the European Union, blockchain-based systems will not eliminate the need for financial intermediaries; they will create a substitution of traditional intermediaries that will require fewer regulations
7	By 2030 in the European Union, blockchain entrepreneurship will be focused in designing financial credit services aiming at improving lending practices around efficiency, efficacy and security
8	By 2030 in the European Union, most financial services providers will need to radically change their business model in order to adapt to the innovation brought by blockchain-based systems both in terms of infrastructure and service provided
9	By 2030 in the European Union, companies that will digitize/ tokenize their assets via blockchain-based systems will have a competitive advantage and benefit from a higher growth that those who won't implement it
	Technological
10	By 2030 in Europe, blockchain-based technologies will be commonly used and implemented to trace transactions to the financial statement and for other auditing purposes
11	By 2030 in the European Union, blockchain-based technologies will enhance credit systems reliability enabling them to adopt tamper proof algorithmic executions
12	By 2030 in the European Union, blockchain-based technologies will enable startups and SMEs to have access to loans without the need to provide collaterals
13	By 2030 in the European Union, blockchain-based technologies will allow to issue and transfer equity shares on the exchange's private marketplace by replacing the current paper certificates system
14	By 2030 in the European Union, ICOs will be commonly used as a way to finance a project, but they will be subject to strict regulations that will ask for many details, such as the code source, and the type of tokens issued
15	By 2030 in the European Union, most transactions (e.g. payments, property exchanges) will be carried through blockchain-based systems to ensure reliability and transparency
	Business
16	By 2030 in the European Union, major blockchain applications will be private, among consortiums and company agreements
17	By 2030 in the European Union, public blockchains will remain for cryptocurrencies as a form of capital investment
18	By 2030 in the European Union, thanks to blockchain-based systems, companies will have access to the digitization of their shares and will be allowed to issue tokenized bonds
19	By 2030 in the European Union, blockchain tokens will allow more and more open-source projects to raise funds and support continued development by repaying the developers contributing to the project
20	By 2030 in the European Union, smart contracts will be highly adopted for trust-less transactions in financial and economic markets, also extended to stocks, bonds, futures, loans, mortgages, property rights, intellectual property and other contracts

In order to avoid over-complicating the survey, it was decided to use only the presented twenty projections. Indeed, some authors, such as Parent and Anderson-Parenté (1987),

have proposed certain limits on the number of Delphi questions, e.g. 25, to guarantee a high response rate and properly filled-in questionnaires, including only closed answers. In this dissertation was decided to add also the possibility to comment the given answers in order to gather additional qualitative data to improve the quality of the results considerably, and also because this solution is in line with the von der Gracht methodology.

5.2. Selection of Panel of Experts

Regarding the selection of the blockchain experts that took part to the survey, several companies and institution were chosen due to their experience in the field. Those who demonstrated high degree of skill in or knowledge as well as were willing to take part in the survey, were selected to be part of the panel. Moreover, according to Adler and Ziglio (1996) and as pointed out by Heiko A. von der Gracht (2008) there are four requirements for "expertise":

1. Knowledge and experience with the issues under investigation
2. Capacity and willingness to participate
3. Sufficient time to participate in the Delphi
4. Effective communication skills

The interest the experts have on the study is really important, since the effort required to take part in a Delphi research is higher than conventional one-round surveys.

For the reliability of the study the selected panellists should have different backgrounds and profiles and for this the specific purpose of this dissertation, must have experience with the technology in different European countries. It was decided in fact to consider the working country or countries rather than the nationality, since the latter is not an indicator of their knowledge about the degree of innovation in a country. Twelve European countries were reached in total, being France and Italy the ones with the highest number of respondents. The former one due to the fact that the facilitator has lived in Paris during the time of the implementation of the Delphi methodology, giving him the opportunity to participate to conferences and workshop were mainly French experts were present. The

latter since Italy is the country of origin of the facilitator and he was able to exploit contacts that he had thanks to different working experiences in consulting.

The following bar chart shows the distribution of the countries were the experts taking part to the survey work more and have experience with.

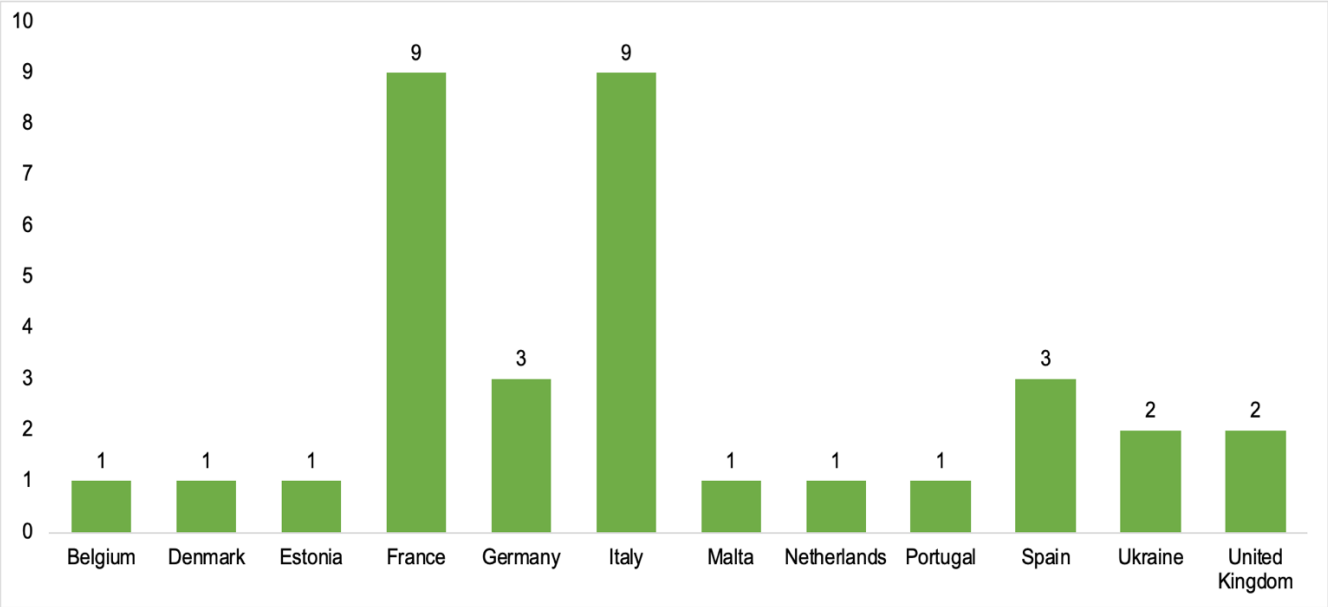


FIGURE 22 - EXPERTS MAIN COUNTRIES OF WORK

Additionally, during the first round, the expert's name, the expertise number of years in the blockchain field. These data allowed further reflection in the analysis of the results. According to Geschka (1978) a panel size of 15-25 participants is usually considered sufficient, in the case of this research a panel of 35 experts have been reached for the first round.

The experts who participated have different years of experience, varying from 1 to 6.

Four (11%) have one year of experience, nine respondents (26%) have two and three, six (17%) have four and five, while only one expert has more than five years of experience.

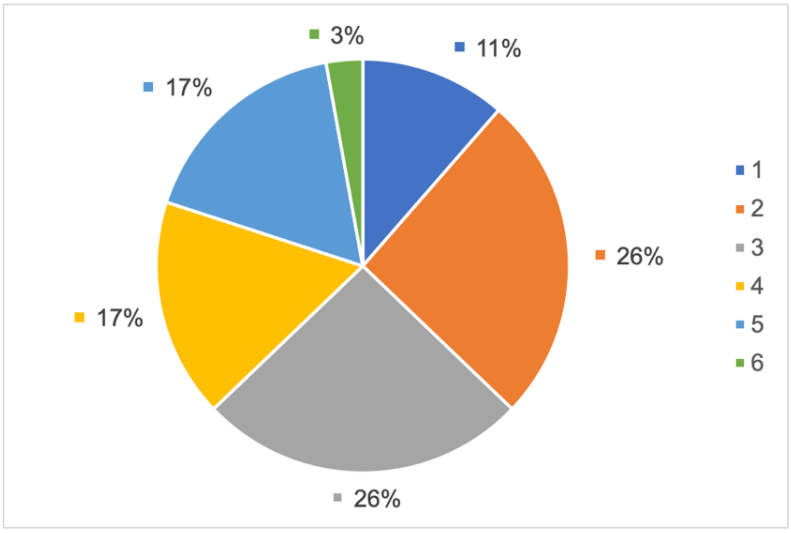


FIGURE 23 - YEARS OF EXPERTISE

The experts of the panel have different backgrounds representing several difference fields of competencies, as it is possible to see in the subsequent figure.

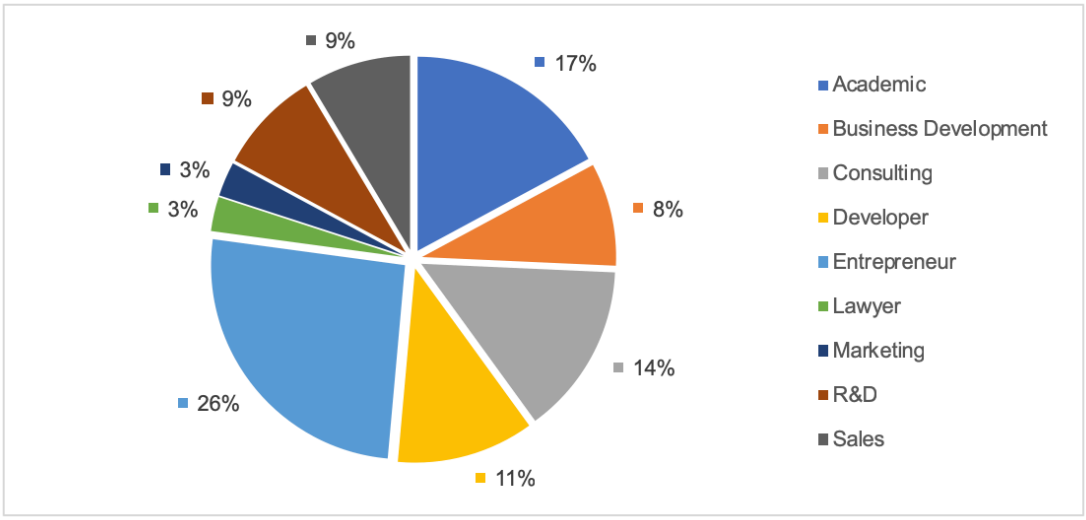


FIGURE 24 - FIELDS OF EXPERTISE OF THE EXPERTS

The biggest slice of the pie chart is represented by entrepreneurs, this stresses out how many realities developing and innovating around blockchain technologies are emerging and have emerged in recent years only. Consequently to this emerging trend of new

entrants, consultancy firms have jumped in in order to guide and lead the development of Proof of Concepts and projects for both start-ups and incumbents. Many of the consultants that participated to the survey are working for traditional banks connecting them with the fintech environment. It is not a surprise then that many of the panellists were consultants for big technology consultancy firms. Developers represent the 11% of the panel. This is also an interesting data, showing how in order to make blockchain projects possible developers are a compulsory resource. Even though they still represent a scarce and expensive resource, more and more people are getting skilled with developing techniques and languages that are needed for blockchain such as Solidity. The fourth remarkable slice is represented by academics, many universities in fact are now introducing research and development activities as well as courses going from developing and computer science until business, legal and ethical issues, covering in this way all fields that are impacted by blockchain.

5.3. Execution of Delphi Survey

According to the Gracht and Darkow methodology, the facilitator conducted two survey rounds. The facilitator opted to carry no more than two rounds for a practical reason. Participating to the Delphi methodology requires a lot of effort and is time consuming for the panellists, so limiting the rounds to two has been decided in order to minimize the effort of experts and prevent them from leaving the investigation. This allowed to reach a sufficient number of respondents that allowed to finally have valuable results and consistent conclusions. Moreover, since for each scenario the possibility to include a qualitative argumentation was included, the small number of iterations have worked as a stimulus for the expert to fill the short open answer explaining the reasons of his quantitative answers.

The survey was carried out following the standards of the Internet-based Delphi, also called e-Delphi. Allowing respondents to answer digitally allowed the experts to be more flexible in times and ways of responding to the survey, ensuring greater participation. The way the questionnaire was structured was exactly as e-Delphi website suggests, but for practical and easiness reasons the facilitator preferred to edit the survey using Google forms.

Other standards, such as the real-time Delphi solution proposed by the similar German study (Jiang et al., 2017) could lead to a better comparison between experts, but they are way more difficult to implement, causing more withdraws to the survey.

The image below shows the main steps that were taken to carry out the research. The facilitator started by interviewing experts and studied the literature related to the topic in order to prepare the scenarios to be tested. The first round of the survey helped him find out the scenarios that reached a higher degree of consensus and those who instead had to be re-tested through the second round. During the second iteration of the survey, the results of the first Delphi's round were reported as attachment, indicating both qualitative and quantitative anonymous answers, to the panel experts in order to facilitate the consensus among the experts during the second round. At the end of the process execution, the facilitator collected all the data generated to make a report with a summary of the results obtained.

FIGURE 25 - THE DELPHI TECHNIQUE (HEUR & PHERSON, 2011)

5.3.1. Round 1

In the first round of the survey, the experts assessed twenty projections regarding their expected probability and impact. Some Delphi researches include a third factor to assess the desirability of the scenario, i.e. how much an expert is in favour of the realization of a prediction, but for the practical reason of making the questionnaire lighter and faster to

compile, it was decided not to include it. This decision allowed also to benefit the number of scenarios to be assessed. Always in line to keep the survey as light as possible, the evaluation of the impact was limited to an industry level and not divided into other dimensions, such as societal, since almost all mainly scenarios were of an industrial background. Impact was measured on a five-point Likert scale.

When editing a survey following the Delphi methodology, as for many other surveys involving the use of psychometric theory, rating- and Likert-type scales are often used, however there's not a general consensus among experts regarding on how many points the scales should be made. Scales made with eleven-point are generally considered as too confusing and misleading to be processed by a human mind, that can't understand the slight differences among each of the numbers. Scales instead with less than five-points are considered insufficient to achieve satisfactory results, and they lead to a greater degree of difficulty explaining the variance among the subsequent behaviour of the judges. According to Von der Gracht (2008) a nine-point percentage rating-scale for probability measurement allows more powerful statistical tests to be applied, having the same properties of an interval-scale. He claims that there is a general understanding in Delphi literature about these long percentage scales: "they can be considered as interval scales with a not significant measurement error" (Von der Gracht, 2008). Moreover, it was possible for the Blockchain experts to provide a written argumentation for each estimated probability. Thanks to these open answers and reflections the facilitator was able to generate valid qualitative reasons to provide in the second round of the survey some anonymized answers that led to the choices of the first round. This helped to develop consensus in the second round, and so most reliable scenarios. However, in this study the assumption that a rating-scale may be equated to an interval-scale was considered excessive.

Differently from Von der Gracht research, in this research only five-point percentage scale was used to assess the impact of the probabilities. This decision was taken because the facilitator understood during the exploration phase that a nine-point scale was too complex to specific and complex for the type of work-done. The projections to be evaluated, in fact are not described in detailed and thus it is hard to differentiate from 10% to 90% their probability of occurance. Due to this high-level nature of the scenarios it was preferred and suggested to use a five-point scale, i.e. 0%, 25%, 50%, 75% and

100%. The following screenshot (Figure 26) shows an example on of how the developed projections were tested in the first Delphi round.

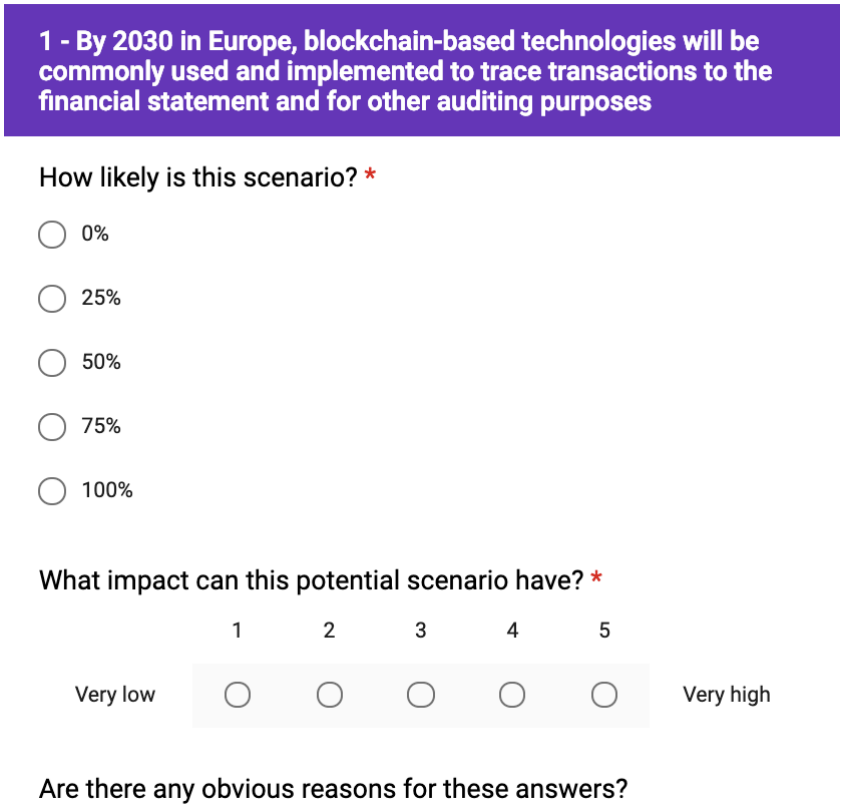


FIGURE 26 - ROUND 1, PROJECTIONS 1 - TESTING EXAMPLE (GOOGLE FORM)

Gathering quantitative data allowed the facilitator to perform an interim analysis based on descriptive statistics such as, median, mean and interquartile range (IQR). Literature regarding the Delphi method does not suggest a standardized way to measure consensus, but normally measures of central tendency, such as median and mean values, give a first understanding and are frequently accepted and adopted. For this reason, they were calculated also for this research.

According to Von der Gratch the IQR target value depends on the number of response choices. In case the experts are provided with a high number of choices, the value of the IQRs can increase, so that the higher the range of the Likert-scale for instance, the larger the IQR can be in order to consider a consensus as reached. Literature suggests that an IQR of less or equal to 2 for a 10-unit scale or an IQR of less or equal to 1 for a 4- or 5-unit scale is acceptable. However for the lack of simplicity, in this study, scenarios with

an IQR of 1.5 were considered as having reached an acceptable degree of consensus. Thanks to this decision it was possible to reach a high conversion of responses in round 2. “The IQR is the measure of dispersion for the median and consists of the middle 50% of the observations. If an IQR has a value of one or less means that more than 50% of all the experts’ opinions fall within one point on the used measure scale” (Von der Gratch, 2008). It is important to state and to pay attention during this phase of data analysis, since not all statistics are allowed when dealing with data. For instance, in this research the percentage-rating scale is not considered as an interval scale, and thus doesn’t benefit from the interval-scale properties, meaning that the mean values that are presented in the dissertation are to be intended as qualitative. The decision to use the median instead in order to assess the consensus together with the IQR, was taken because for such a small panel, using the mean could have been misleading due to the presence of outliers.

Finally, it is important to say that big efforts are required in order to find a panel of experts that engaged in such a time-consuming research. The facilitator, had to send one or two reminders to the fifty selected experts that agreed on taking part on the study, but sometimes was not enough and after a second reminder the expert was excluded from the panel.

5.3.2. Interim Analysis

Through an interim analysis a first assessment of the results obtained is made and this allows to develop the questionnaire for the second round of Delphi. Accordingly with Von der Gratch, three steps of analysis were undertaken:

1. Qualitative data was inspected
2. IQRs were measured in order to assess the degree of consensus
3. Outliers and extreme points were analysed in case of consensus

Regarding the analysis of qualitative data, more than 200 comments were gathered. Some of the argumentations are not significant and do not really explain the reasons behind a certain choice, while other experts provided more details and tried to better explain their choices. Of the latter ones, the most significant are reported as an appendix in Chapter 7.

The analysis of the comments also allowed the facilitator to understand if there was some misunderstanding in the projections among experts. This in fact has been the case for one of the projections, for instance projection number 10, probably due to the presence of an English word of non-common usage that has led to confusion in understanding the scenario. Thus, the wording was modified for the second round of the Delphi in order to make the scenario easier to evaluate. Another comment arose for projection number 18 since two experts found it redundant and had the feeling of having already answered that question in a previous scenario. This might have been a generalized problem, and also other experts might have had difficulties in understanding the purpose of the scenario. This might have been a factor that led the scenario to not reach a consensus in round 1. Thus, it was decided to propose it in the second round changing the wording and clarifying the doubts. Regarding the second step of the analysis, consensus was considered achieved for those scenarios with an IQR equal or lower than 1.5 for the probability five-point Likert scale. The calculation of IQR was automatized in Excel using VBA programming language. For each scenario a button has been created that automatically returns the IQR value on an output sheet. In the first round consensus was reached for thirteen projections over a total of twenty, 65%.

The results of the first round are presented in the table below, in which scenarios that reached consensus are highlighted in grey.

Projections	Round 1		
	Probability		Impact
	Median	IQR	Median
Socio Cultural			
1 - Education and knowledge	0,5	2,5	4
2 - European Union as leader hub	0,25	1,5	4
Policy and Regulations			
3 - Security and cost reduction	0,75	1,5	4
4 - Standards and governance	0,75	1	4
5 - Regulations will foster innovation	0,5	2	4
Economic			
6 - Intermediaries	0,5	1,5	4
7 - Financial credit services	0,5	2	4
8 - Change business model	0,75	1,5	4
9 - Competitive advantage	0,75	1	4
Technological			
10 - Trace transaction and auditing purposes	0,75	1	4
11 - Reliability of credit systems	0,5	2	4
12 - Access to loans	0,5	2	4
13 - Issue and transfer equity shares	0,75	1,5	4
14 - Financing through ICOs	0,5	2	4
15 - Reliable and transparent transactions	0,75	1	5
Business			
16 - Private blockchains	0,5	1,5	3
17 - Cryptocurrencies	0,5	1	3
18 - Digitization of shares	0,75	2	4
19 - Open-source projects	0,75	1	4
20 - Smart contracts	0,75	1	5

FIGURE 27 - FIRST ROUND ANALYSIS

As shown in the table above, only two statistics have been used, since, as previously have been explained the scale used to gather quantitative data didn't support the use of other types of statistics. For the probability of each scenario both the median value and the interquartile range were calculated, while for the impact only the median values are reported.

Mean values are not reported, since as already mentioned before, for such a small panel of respondents, means could be extremely biased due to the presence of outliers, making them an unreliable statistic to assess the consensus. However, it was decided to develop the likelihood-impact map below to have a qualitative interpretation of the results and to represent them graphically.

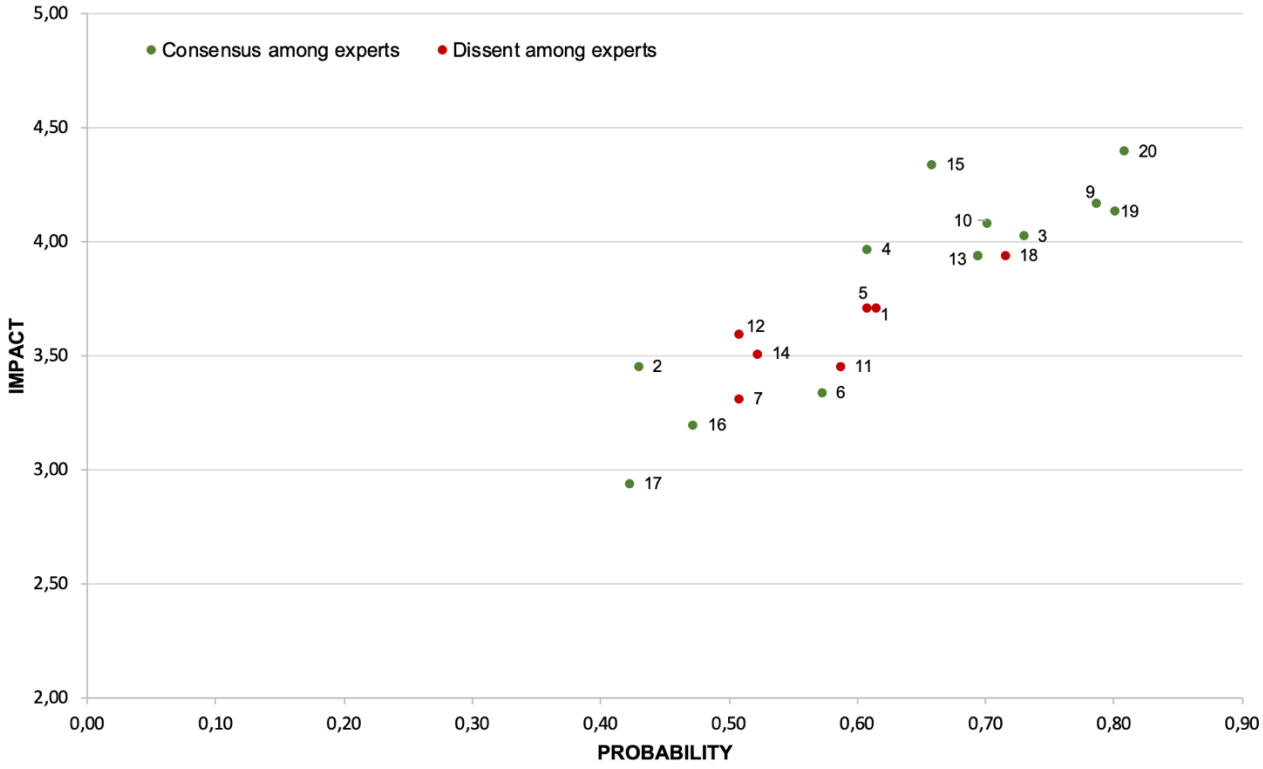


FIGURE 28 - FIRST ROUND LIKELIHOOD-IMPACT MAP

Each point in the map represents the projection which number is written next to it. It is direct to notice a linear trend among the points, such that if a scenario is considered to have a low probability of occurrence, it also has a low impact. This could be related to the fact that it is difficult to the human mind, and thus for the experts that are involved, to separate the concepts of likelihood and impact. This bias is inevitable, and it seems that if a projection is unlikely it will also have a weak impact.

Most of the projections that achieved the highest probability, having a median value of 75% achieved also the consensus, i.e. IQR below 1.5. This was the case for projections

3, 4, 8, 9, 10, 13, 15, 19, 20. These results show how for the projections that were considered very likely to occur it was easier for experts to find a consensus. Only projection number 18 has the highest probability but couldn't reach consensus. This might be due to the redundancy highlighted by some experts that might have led them to answer the questions related to that scenarios without putting the attention required or without really understanding it. On the other side projection number 2 reached consensus, even though it was considered very unlikely, median of 25%.

The highest IQR reached is 2.5, but it is present only for projection number 1 and it might be due to the terminology used that was very general and experts could have interpreted the wording differently. All other projections have an IQR equal to two, projections number 5, 7, 11, 12 and 18.

- Projection number 1 shows how some of the experts agree on the fact that most of the people will have a good knowledge about what a blockchain is and how does it work, while others consider that, as it happens for the internet, most of the people will use it without knowing the technologies behind and how they are combined together. The formers argue that many institutions, companies and universities are already teaching and training their employees or students regarding the topic. However, this spread of knowledge is limited to high level education and it is impossible to generalize it for the entire population. Furthermore, many experts agree in the fact that the impact of education regarding blockchain solutions is high and governments should foster its deployment, financing teaching and training sessions.
- Projection number 5 sees different opinions regarding the current situation of the European Union. Some experts argue that is already too late for the EU to catch up against countries like the United States, China and South Eastern Asia, while others are more positive and are happy with the regulations and the direction that the European Commission has taken so far and is undertaking for the future. However, a general perception of being late is present, and this is linked with projection 1 and the low level of education that is perceived among the member states. This leads to a general statement that EU will rather allow innovation rather than foster it.
- Projection number 7 presents a debate among experts who are rather confident regarding the digitization of lending practices and think that the blockchain is going

to focus on this industry mainly, being a boost for efficiency, efficacy and security. Other experts instead believe that by 2030 blockchain will be broadly adopted in all kind of fields, and thus entrepreneurship activities will not only be focused in improving financial instruments, but many start-ups will grow to generate value in many different ways.

- Projection number 11, as already mentioned, was probably not very clear to some of the experts. The terminology tamper-proof, used to described blockchain algorithm, led to some confusion and misunderstanding. Thus, some experts probably didn't answer correctly and in line with their thoughts. Among the others who probably understood correctly that by *tamper-proof* it was meant that blockchain-based technologies will enhance credit systems reliability so that they cannot be interfered with or changed, agreed on the fact stating that this kind of property is the basic one to refer to a blockchain system. Without this property it is not possible to talked about blockchain. However, some experts stated that blockchain in the future will have different degree of security, primarily due to the increasing development of private ones that are not as immutable as public ones.
- Projection number 12 sees experts who are very positive regarding the paradigm shift that will lead to a complete disruption of how now companies are accessing to capital and to loans. Some experts mentioned how already ICOs are an example of a trend and a need that cannot be stopped. Even if eventually ICOs will not remain as are known today, many other instruments and models will arise to allow an easier and faster access to capital without the need to provide collaterals to banks or traditional venture capitals.
- Projection number 18 presents experts claiming that the tokenization of bonds is already happening right now, and that by 2030 it will be a commonly used practice, while other experts that are more worried about their large adoption due to the high opposition of banks and governments that will fight to retain their privileges.

These projections, given the wide gap in opinions, were tested again during the second Delphi round. Now will follow an analysis that takes into account the qualitative comments provided by the experts, the quantitative results, as well as the 13 interviews previously carried out.

Projections 1, 2 and 5

Projections 1, 2 and 5, if taken together, highlight the controversial opinions regarding the degree of knowledge people will have in the future and the actions the European Union will take to foster or slow down the process. Many experts agree that like is happening for the internet now, many people will use it without knowing exactly what is it and the technologies that allow them to send an email for instance. They claim that for the blockchain will be the same, people will inevitably use it and take advantage of it, without even being aware. This relates a lot on the degree of education that European institutions will allow, and moreover on what aspects of the technology educate the students about. It is important that serious actions are taken in order to avoid behaviours that could be unethical or that could lead to big and costly mistakes. Other experts look at the education level of the European Union as not sufficient and are sceptical regarding fostering activities coming from the public administration. They rather believe that governments and regulatory institutions will be obliged to adapt to the pace of innovation, but they will be always catching up the technology rather than simplify its evolution.

Thus, a scenario in which Europe will lead blockchain innovation is very unlikely to happen (projection 2). Regarding this particular aspect experts reached a high degree of consensus on the round 1 questionnaire, but also during the initial interviews most of the experts would not bet in Europe as a leading hub for blockchain solutions. Of course, blockchain-based solutions are being developed and implemented and in the future they're presence is not an option, but it will be a compulsory development in order to remain competitive.

"Education is the most powerful weapon which you can use to change the world."

Nelson Mandela

Projections 3, 4 and 5

These projections are all related to policies and regulations, although not all three reached a consensus in the first round, for instance projection 5 has an IQR equal to two, they're all positively correlated, showing a consistency in the answers of the respondents. The main outcome is that regulations will aim at increasing the level of security regarding both the reliability of the transactions and the management of the data. Experts agree on considering likely possible the scenario in which thanks to new policies and laws the legal barriers that blockchain is now facing will be knocked down and it will be possible to ensure fair and secure access to data. Some standards will emerge for all the challenges regarding the personal data protection and digital identity management. How the European Union is going to achieve the equilibrium and allow a secure and regulated implementation and adoption is instead not clear. Experts answered differently regarding the fact the in European Union regulators will foster innovation through directives aiming at enhancing entrepreneurship activities and research and development. Some of them argue that regulations will be able to speed up adoption, while others are less positive and simply claim that the European Union will finally adapt to the situation but it will be more a bottom up process coming from a need of entrepreneurs and from the entire industry, rather than a top down willingness to foster the adoption.

Projection 6

This projection regarding the possibility for blockchain to eliminate financial intermediaries, reached consensus, but experts commented with different argumentations. Also the likelihood that new forms of intermediaries will emerge, or that existing ones will change and they will require fewer regulations is not very high (median of 50%). This could lead to the conclusion that blockchain is going to eliminate all form of intermediaries in the future, like clearly claimed by one of the experts: *"Blockchain aims to eliminate intermediaries, there is no point in using a Blockchain and also keep them"*. But this view is not really in accordance with insights that the facilitator was given during the initial interview phase, also other experts for example commented that regulators will always need a certain degree of control and thus that somehow intermediaries will always exist with the need of ad-hoc legislation. This scenario is defended by many experts that see in a total absence of intermediaries a sort of uncontrolled anarchy that won't be

possible to manage, also many traditional institution are fighting against this scenario to occur in order to defend their privileges, as stated by one panellist: *“On one side, lobbying from financial intermediaries to protect themselves. On the other hand, the necessity to identify a legal entity to be controlled by the regulators”*. This controversial situation and thoughts lead to an unclear evolution of institutions, but it is possible to conclude that all agree that traditional and now existing intermediaries won’t exist anymore, either they will change adopting new solutions, or they will be disrupted.

Projections 7 and 11

These projections aimed at understanding the confidence experts have on the possibility for blockchain to become a means to disrupt the access to credit for private people and companies. Lending practices will for sure be affected by the technology and by 2030 there will exist instruments that will allow an easier access to credit, but this will not be the only focus for entrepreneurial activities regarding the blockchain. Many other sectors will implement blockchains leading to different business models and organizational structures, so that flexibility on entrepreneurship will be required. Both projections though didn’t reach consensus in the first round, in fact for projection number 7 many experts argued that financial credit systems will not be the only focus, as one of the experts commented: *“I don't see a real focus on credit. Basically, Blockchain will be approached differently. I think we are really limited because people are afraid of changing their business model. I hope they will realize”*.

Regarding projection 11, as already mentioned previously, problems arose due to the wording that has probably led to confusion among the experts. Besides this confusion it is interesting to highlight the correlation between the two projections since shows how experts who do not believe that entrepreneurial activities will be focused on credit services also believe on a lower level of reliability of the credit systems working and operating using blockchain based technologies.

Projections 8, 9 and 10

Projection 8 aimed at measuring how much experts thought that financial services providers should start innovating and becoming aware of the potential of blockchain right

now in order to stay competitive in the years to come. The projection reached consensus, meaning that most of the panel agreed on the fact that incumbents, must start training and developing use cases in order to be ready and flexible to adapt to the shift of business model that blockchain will bring to the industry. The need is clear, but of course its implementation is not easy, and many are finding difficulties in allocating budget for trainings or research projects in the field. Most of the experts though are aware of this need and agreed saying that those who won't innovate and won't change mindset from today already, won't be flexible enough to adopt fast new business models that will arise, such as tracing transactions to the financial statement and for other auditing purposes from distributed databases (projection 10). This scenario for example, besides implying the need of training all the auditing department on the usage of blockchains and their understanding of it, requires investments on new infrastructures and software as well the ability of writing off sunk costs. This latter requirement is not to be missed out, many companies in fact find it very hard to declare past incurred costs as sunk and quit projects on which they spent a lot of efforts.

This of course leads to projection 9, relating the process of innovation in order to gain a competitive advantage. Experts strongly agree that those companies that will digitize/ tokenize their assets via blockchain-based systems will have a competitive advantage and benefit from a higher growth that those who won't implement it. This scenario of course represents a complete different mindset on how companies are managed and financed leading to completely new ways to think financial statements and the entire structures of companies.

"Without change there is no innovation, creativity, or incentive for improvement. Those who initiate change will have a better opportunity to manage the change that is inevitable."

William Pollard

Projections 12, 13 and 14

These three projections taken together were specifically made to understand the likelihood of the digitization of assets via blockchain and how blockchain could help in democratizing the access to financial resources for start-ups and SMEs. Being more

specific it was harder for experts to reach a consensus, projections number 12 and 14 in fact didn't reach an IQR of at least 1,5. A generalized belief is that companies will have easier access to capital thanks to blockchain, but is still not clear how this is going to be regulated and the actual instruments that will be used and how they will actually function. By democratizing investments opportunities, potentially blockchain allows companies to receive funds without the need of providing collaterals, but this scenario is debated strongly among the community and in fact didn't reach a consensus in round 1. Thus, it remains still unclear if and how companies will need to provide documentation to prove that are reliable in order to receive capital investments. Same reasoning can be done for projection number 14 that treats the hot topic of ICOs. After the bubble in 2017 in which many companies raised huge amount of money thanks to this model, now the community looks at them suspiciously, since governments and regulatory institutions jumped in to avoid the raise of scams and unethical usages and behaviours. But ICOs represent another example of innovation enhanced by a bottom up process. As one of the experts commented: *"ICOs have been used to compensate for a lack of business model sustainability and will only be used to supplement other methods of financing in the future"*. The latter part of his sentence seems to suggest that ICOs will remain in the future, but that will be among other forms of financing methods, as another expert argued: *"ICOs will become a method similar to VC funding. STOs will become normal"*. Many experts agree with this latter sentence, what will lead to the development of hybrid financing methods between the unregulated and messy ICOs and a traditional VC funding or IPO. In STOs for instance, similarly to an initial coin offering (ICO), an investor is issued with a crypto coin or token representing their investment. But unlike an ICO, a security token represents an investment contract into an underlying investment asset, such as stocks, bonds, funds and real estate investment trusts (REIT).

A security can be defined as a "fungible, negotiable financial instrument that holds some type of monetary value," i.e., an investment product that is backed by a real-world asset such as a company or property. A security token, therefore, represents the ownership information of the investment product, recorded on a blockchain. When you invest in traditional stocks, for example, ownership information is written on a document and issued as a digital certificate (e.g. a PDF). For STOs, it's the same process, but recorded on a blockchain and issued as a token.

Regarding projection 13, it reached a higher degree of consensus. Experts believe then that blockchain-based technologies will allow to issue and transfer equity shares on the exchange's private marketplace by replacing the current paper certificates system. The digitization of the shares will translate in higher efficiency and easier access to capital. This scenario has reached a consensus probably because it didn't specify exactly how the transactions through blockchains would happen. In conclusions after having analysed these three scenarios together, it is foreseeable that blockchains will allow easier and faster investments on both the side of the investor and the side of the company receiving the funds. The way and specifics that the instruments will have in order to achieve this innovation are still to be defined, but from many agree in saying that even though the technology allows a complete anarchy for investments, regulations will stop and define the boundaries and limits of usages in order to guarantee a high degree of security and transparency. More probable outcome will be to see hybrid forms of financial instruments between ICOs and typical IPOs.

Projections 15, 19 and 20

Thanks to the calculation of correlations it was possible to notice how projection 15 is positively correlated with projection 19 (coefficient of 0,4) and 20 (coefficient of 0,6). It is interesting also how all three projections have a high degree of consensus with IQR of 1,0 and median of 75%.

By analysing the comments and argumentations it is possible to understand how experts are quite confident that by 2030 all common transactions such as payments will be carried out through blockchain systems and traditional architectures will be abandoned. All experts agree that this paradigm shift will bring more reliability and efficiency managing transactions as well as the transparency that is embedded is all types of blockchains. By being confident that blockchain will bring easier and faster transactions it is quite logic the link with projection number 19 regarding the financing of open source projects. Also, this scenario finds experts in line with their answers and the fact that developers will be rewarded through blockchain tokens for their contribution to projects seems very likely to happen. Thanks to blockchain in fact it will be possible to track transparently the contribution of whoever participates and pay them efficiently and safely. The easiness blockchain will bring in managing transactions will thus allow new business models, such

as the rewarding system for open-source projects, to arise. Other strong correlation is present regarding the adoption of smart contracts. Smart contracts in fact are the ones that will allow transactions to occur and as I said before their implementation will be spread in all type of property exchanges allowing trust-less transactions in financial and economic markets, but also extended to stocks, bonds, futures, loans, mortgages, property rights, intellectual property and other contracts.

Projection 16 and 17

Projection 16 aimed at understanding how much probable is the scenario in which mainly private blockchains will take off, while public ones won't be used for practical and operational objectives. The fact that major blockchain applications will be private, managed thanks to the collaboration among consortiums and company agreements, is a scenario that experts do not see very probable. This conclusion, similarly to projection 6, is not supported by the other type of primary data that the facilitator gathered thanks to face-to-face interviews. Many experts that participated to the first phase of the Delphi methodology, as well as many speakers that presented in the conferences and workshops the facilitator participated, considered highly probable the prevalence of private blockchains over public ones, due to the fierce opposition of traditional institutions. However, the transition will not happen very fast, thus incumbents will be able to adapt to changes and also to shape the adoption in their favour. In accordance with this view is interesting to notice that the median of the impact for this scenario in the first round is 3, which is not very high compared with the other scenarios, meaning that the industry will have the time to catch up with new technologies and business models, lowering the disruptive potential. Furthermore, a point of attention is the negative correlation that projection 16 has with projection 17, which is instead related to the evolution of the usage of cryptocurrency and how the market is going to evolve and change in the future. In particular the relation between cryptocurrencies and public blockchains was analysed. From the correlation is possible to comprehend that the experts who considered probable the stabilization and major adoption of private blockchains, considered less probable the use of public blockchains and cryptocurrencies for capital investment, as one of the experts commented: *"In the future public blockchains could face major changes in the*

consensus model, what could alter the evolution and applications cryptocurrencies could have".

Projection 18

The scenario in which companies will have access to the digitization of their shares is a very controversial one. As for scenario 13 a lot of confusion and different opinions were gathered all along the research. The high degree of difficulty in evaluating such a scenario led to not reaching consensus in round 1 and this scenario will be tested again in round 2. However, the median value regarding the likelihood is quite high (75%), that in accordance with what already mentioned for projection number 13, experts are confident that the digitization of assets and shares will take place, and that blockchain will be a good means to achieve it, but the technicalities and specific details on how this is going to happen as well as what will be the dominant design of the instruments is still unclear.

5.3.3. Round 2

During the Delphi's second round only the projections with an IQR above 1,5 were tested. In order to allow the respondents to easily understand the answers that the panel gave as a whole in round 1, for each projection was provided a quantitative report, i.e. a bar chart with the distribution of round 1 answers and qualitative details, i.e. some of the argumentations provided by some of the panellists. Experts were asked to reconsider the likelihood of occurrence of projections 7 projections, in particular number 1, 5, 7, 11, 12, 14 and 18.

The second was again structured using Google Form. In Figure 30 an example of the structure of the new questionnaire is provided. According to Delphi's literature, it was decided to not ask again the impact estimation of each projections, since it should not be subject to any change. Moreover, it was decided to leave the opportunity to offer again some qualitative comments in support of the answers for a better analysis of the results.

The number of experts who successfully completed the second round of the survey are 28, i.e. the 80% of the experts that completed Round 1 and 56% of the selected initial panel.

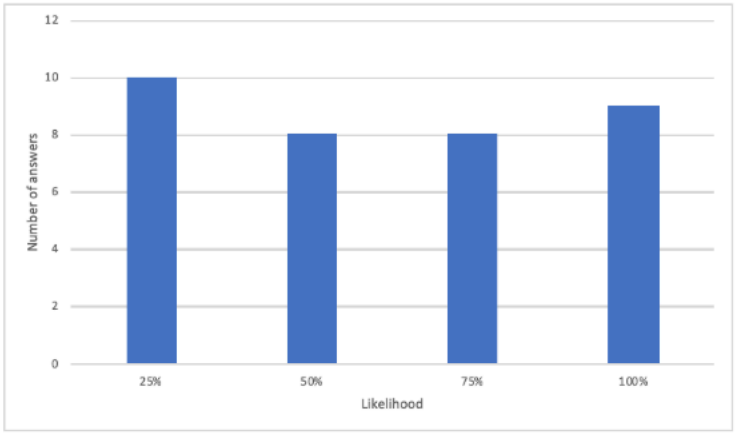
	Survey invitation	First round	Second round
No. Of experts	50	35	28
Percentage	100%	70%	56%

FIGURE 29 - SURVEY DROPOUTS

A drawback of the method is of course the lack of qualitative comments when dealing with the second round. First reason is that not all experts provided relevant arguments for their answers in round 1, second reason is that, even if all commented, it would be way to heavy to provide all the arguments in the form of the second round. Due to these reasons and in order to avoid a higher drop rate, it was decided to choose only the most relevant arguments to be shown in the second round. Unfortunately, this is a limit of the research method, since by favouring simplicity, respondents are influences only by answers of some experts and not all of them.

1 - By 2030 in the European Union, most people and companies will have a degree of knowledge about what a blockchain-based system is and how does it work

Likelihood - Round 1



25% - Just like the Internet people do not really know the technology behind it, but this is not relevant for its application

25% - Blockchain is the machine room, people will know how to use it, but not its technical functioning

50% - Blockchain will become embedded in most our day to day activities and will be taught as an elective (at least) in schools/universities

75% - Assuming further consolidation across industries, large enterprises will increase their efforts and resources aimed at leveraging blockchain to avoid being left behind

100% - The need of Blockchain knowledge will be obvious, many school already add Blockchain programs to their masters

After evaluating the results of the first round, what likelihood has this scenario? *

- ◯ 0%
- ◯ 25%
- ◯ 50%
- ◯ 75%
- ◯ 100%

Do you want to add any comment to your answer?

FIGURE 30 - EXAMPLE FROM THE SECOND DELPHI ROUND

Subsequently, it is possible to find statistics for the second round of the survey. As in the previous case, the projections that have reached consensus are highlighted in grey. Of seven projections that were tested, four reached consensus in the second round (1, 5, 11 and 18), while three (7, 12 and 14) still present an IQR equal to 2. However, even if not all the projections reached an acceptable degree of consensus, these results result show that the Delphi method can actually lead to greater degree of agreement.

Projections	Round 2		
	Probability		Impact
	Median	IQR	Median
Socio Cultural			
1 - Education and knowledge	25%	1,25	4
2 - European Union as leader hub	-	-	-
Policy and Regulations			
3 - Security and cost reduction	-	-	-
4 - Standards and governance	-	-	-
5 - Regulations will foster innovation	75%	1,25	4
Economic			
6 - Intermediaries	-	-	-
7 - Financial credit services	50%	2	4
8 - Change business model	-	-	-
9 - Competitive advantage	-	-	-
Technological			
10 - Trace transaction and auditing purposes	-	-	-
11 - Reliability of credit systems	75%	1,25	4
12 - Access to loans	37,5%	2	4
13 - Issue and transfer equity shares	-	-	-
14 - Financing through ICOs	50%	2	4
15 - Reliable and transparent transactions	-	-	-
Business			
16 - Private blockchains	-	-	-
17 - Cryptocurrencies	-	-	-
18 - Digitization of shares	75%	1	4
19 - Open-source projects	-	-	-
20 - Smart contracts	-	-	-

FIGURE 31 - STATISTICS ON THE SECOND DELPHI ROUND

CHAPTER 6 – Results and Conclusions

6.1. Results

In order to provide a more effective and structured final analysis of the results, it was decided to first report the final summary table of the Delphi survey and then try to give answers, in the most complete and exhaustive way, to the questions that were suggested at the beginning of the research.

Projections	Round 1		Round 2		
	Probability		Probability		Impact
	Median	IQR	Median	IQR	Median
Socio Cultural					
1 - Education and knowledge	50%	2,5	25%	1,25	4
2 - European Union as leader hub	25%	1,5	-	-	4
Policy and Regulations					
3 - Security and cost reduction	75%	1,5	-	-	4
4 - Standards and governance	75%	1	-	-	4
5 - Regulations will foster innovation	50%	2	75%	1,25	4
Economic					
6 - Intermediaries	50%	1,5	-	-	4
7 - Financial credit services	50%	2	50%	2	4
8 - Change business model	75%	1,5	-	-	4
9 - Competitive advantage	75%	1	-	-	4
Technological					
10 - Trace transaction and auditing purposes	75%	1	-	-	4
11 - Reliability of credit systems	50%	2	75%	1,25	4
12 - Access to loans	50%	2	37,5%	2	4
13 - Issue and transfer equity shares	75%	1,5	-	-	4
14 - Financing through ICOs	50%	2	50%	2	4
15 - Reliable and transparent transactions	75%	1	-	-	5
Business					
16 - Private blockchains	50%	1,5	-	-	3
17 - Cryptocurrencies	50%	1	-	-	3
18 - Digitization of shares	75%	2	75%	1	4
19 - Open-source projects	75%	1	-	-	4
20 - Smart contracts	75%	1	-	-	5

FIGURE 32 – FINAL STATISTICS OF THE DELPHI SURVEY

- *Will it be necessary to have deep knowledge regarding blockchain technicalities in order to exploit and benefit from its potential?*

The blockchain is a subfamily of technologies in which the register is structured as a chain of blocks containing transactions and whose validation is entrusted to a

consensus algorithm, distributed over all the nodes of the network, that is on all the nodes that are authorized to participate in the process of validation of transactions to be included in the register. The main features of blockchain technologies are the immutability of the register, the traceability of transactions and security based on cryptographic techniques. In trying to understand what the blockchain is, we will rely in many cases on the definitions that are proposed, trying to qualify them. For some, the blockchain is the new generation of the internet, or better yet, it is the *new internet*. It is believed that it can represent a kind of *Internet of Transactions*. Like the internet people will start using and exploit its potential, without really knowing how the technology behind works, in the same way as they send email ignoring how the architecture that allows to communicate works. People will refer to blockchain systems probably as they now refer to browsers such as Chrome, Firefox or Internet Explorer. Many blockchains are right now available and being constantly improved and developed, and it is foreseeable that this will remain the case. Users will just need to know the characteristics that a blockchain provides in order to choose the most suitable one for their business and purposes. Of course, blockchain-based system will require skills and knowledge that developers and engineers must have in order to build and update their products and services, but as for the internet infrastructures we're exploiting today, those skills will be delegated to the experts that build it. Big efforts will be needed to make the blockchain more and more user friendly and attractive for those who just want to benefit from the immutability, traceability and security that allows, without knowing how it does it.

- *Will the adoption of blockchain technologies lead to the entry into new markets and to the expansion of the product range?*

Companies that will integrate in their operation and financial activities blockchain technologies will be able to expand their products and services globally. Another key characteristic of the blockchain is in fact the possibility to connect stakeholders without the approval of a third party in an open, transparent and secure way. This democratization opens the way to offers that are different to those that we're used today. Allowing people to deal freely generates opportunities that were unforeseeable before. Self-enforcing smart contracts let parties to buy and sell products or to rent them with pay-for-use schemes in an automated way, the digitization of shares and assets

allows companies to raise capital in new ways, without the need to rely on banks, venture capitals or traditional IPOs. This are only two examples of services that could be built on blockchain-based architectures, but all industries could be affected, and different product and services will be soon brought to the market changing the game and potentially disrupting existing ones. For the moment many players are investing and innovating on blockchain in order to provide services that will satisfy the market needs. This trend is in line with the Abernathy and Utterback model that explains the non-linear evolution of technologies and their adoptions. In Figure 33 it is possible to see how during the fluid phase the number of firms entering in the market increases exponentially, leading to high rate of product innovation and differentiation. Once a dominant design in product and services will be achieved, those companies that took a different path will exit the market, letting those who will stay to gain market share. Remaining once will then innovate their processes in order to offer the dominant products and services at a lower cost and in a more efficient way entering the specific phase. In this latter phase the performance will grow at a slower pace, being closer to the asymptote.

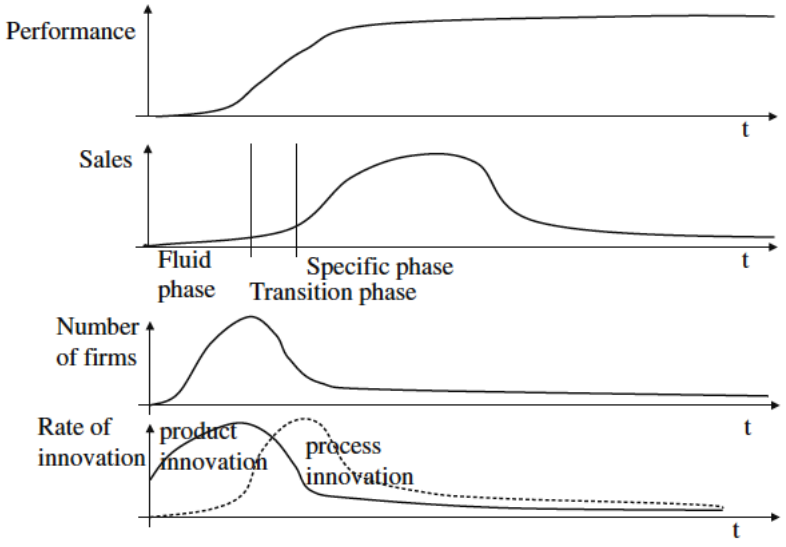


FIGURE 33 - ABERNATHY AND UTTERBACK MODEL

Applying the described model to blockchain technology we can conclude that the new portfolio of products and services that the technology allows, is not defined yet and we're still in the fluid phase of the evolution. However, the pace at which innovation is carried

on suggests that dominant designs of the offerings will soon reach large adoption, since many goals have been defined, but how to get them and achieve the desired outcomes still needs to be fine-tuned.

- *Will the adoption of blockchain-based system lead to a competitive advantage and to significant cost savings?*

  We are witnessing a mix of blockchain native companies and companies adopting technology to improve their existing business processes and to address new market opportunities generated by these new capabilities. In both cases companies are investing hoping to get a competitive advantage over competitors betting on the technology that is promising to reduce costs and increase efficiency. The costs of adoption are right now high and not all companies can afford it, many are superficially investigating other instead are just claiming their doing for marketing purposes ("*Blockchain is like teenage sex: everybody talks about it, nobody really knows how to do it, everyone thinks everyone else is doing it, so everyone claims they are doing it.")* Not many companies though are really exploiting the potential of the technology and thus efforts in this direction will not be repaid. It is of key importance to understand the real competitive advantage that blockchain can bring to its own industry and market, leaving behind other tedious possibilities that will not result in a positive return in investments. To summarize and to help clustering the benefits blockchain can bring, competitive advantages can be divided in:

  - *Efficiency*. Savings in post-transaction costs, which makes more efficient processes of reconciliation of information with counterparts, auditors and regulators.
  - *Security*. Distributed records allow transactions to be verified, and collaboration at different nodes ensures authenticity.
  - *Transparency*. The identities of blockchain users are cryptographically protected, and the system is completely transparent.
  - *Accessibility*. It is a public platform, so any enabled user can obtain a copy of the record.

Blockchain will have to overcome several challenges such as the scalability of its solutions, response times and security before it is used in the common practices of organizations, however it is an issue that is already being addressed by the regulators of

most countries in the world in order to achieve an understanding, contextualize and issue rules to regulate their use. Having clear in mind the advantages, companies should decide whether is worth to invest or if instead would be more profitable to wait until improvements will be achieved and jump in once the adoption costs will be lower.

- *Will the business model of firms remain the same?*

The business model of many companies, in particular of SMEs, will surely not remain the same, but it is important to be more specific about the referred industrial context. The blockchain applies to all types of data and tends towards an increased dematerialization of internal and external processes. In this sense, organizations and businesses are changing and must be rethought. For example, banks are impacted in their core business. They could use the blockchain to create a more efficient interbank network and reduce administrative and infrastructure costs. In parallel, redefine the missions of the middle and back office to focus on front office operations. Activities with low added value are likely to disappear or evolve, therefore it is necessary to develop the appropriate skills to meet the needs of this new market. The blockchain will quickly become part of the lives of companies and individuals by strengthening transaction security and reducing their costs and processing times. Some business models and value chains will be transformed. The questions that arise today are how to apprehend it? How to adapt? How to improve the standards, organisations and the regulatory and legal framework? How to reinvent businesses?

According to Nitish Sing, 2018, there are seven business models that will emerge through the usage and adoption of blockchain technologies.

Token economy. Issue utility tokens that will be used to perform different activities and benefit from different services, providing a strong inventive to end users.

Blockchain as a service (BaaS). Many IT companies such as Microsoft Azure, Amazon Web Services and IBM BlueMix, are willing to become the best providers for those companies that want to adopt a blockchain system but don’t have the means to develop their own. BaaS also eradicates the need for hardware, which in turn, enables startups, companies or organizations to focus on their development cycle without the need to know how blockchain works.

Development platforms. Providers of blockchain technology stack in order to allow other organizations to develop their own applications that will result in a blockchain infrastructure. Hyperledger is one of the first examples of platforms that provides the frameworks, tools and guidelines to rapidly be able to develop an application.

Blockchain based software products. Companies can develop already blockchain based solutions that are ready to be sold to other organizations in need

Network fee charge. Since different activities can be done on a blockchain network, providers can start charging fees to the end users accordingly to the activities they perform. Ethereum for example charges developers to make their decentralized application live.

Blockchain professional services. Companies are willing to pay experts and consultants to have advices regarding the implementation of blockchain-based systems in their organizations. Thus, talented blockchain professionals can use their skills to do business.

P2P Blockchain business model. Enabling end users to interact with each other directly opens up many monetization opportunities charging users or rewarding them for executing certain tasks.

- *Will blockchain-based system allow a complete digitization of the assets of companies? Will this lead to major structural changes?*

The Internet era, or Web 2.0, opened the way to an economy based on the decades-long transition to digital business and online connections. As a layer on top of the physical brick and mortar world, created virtual value resulting in valuation of companies and organizations in stock markets. According to Ronald Coase *(The Nature of Firms, 1937)* firms exists because the costs of business processes is lower if kept inside the boundaries of an organization. This is why firms grow, to make as frictionless as possible flows of information and costs of transactions. With the actual system some processes and transactions must cross the boundaries in order to do business with other entities, but

blockchain technology promises to change the equation that since the internet arrived has defined how companies are structured. By offering a next-level of digitization dollar-valued firms will be substituted by tokens that will allow a decentralized ecosystem that will function as a mega corporation allowing cost efficient processes and transactions among all actors of the supply chain and that will cooperate as part of the same organization. Furthermore, the exponential growth of IoT devices, more than 20 billion connected devices are expected to exist in 2020 (Source: Gartner), will have a major impact on the structure of a company, on information flows and on how work is carried out. IoT devices need to be constantly connected to the internet, collecting, processing and storing data and for this reason blockchain seems to be the only infrastructure capable to provide a secure, reliable and efficient mechanism to allow transactions and communication among these devices. Finally, blockchain will allow to have virtual objects representing real assets that through their tokenization will have their unique identity, similarly to physical ones. This will allow a much easier and transparent evaluation of a company as well as favouring and simplifying trades regarding company assets, such as shares and stocks. In April 2019, the London Stock Exchange, one of the largest regulated exchanges in the world and the second largest in volume in Europe, has collaborated in the first issue of tokenized shares by testing the first Security Token Offering (STO) of its history. The issue relates to the shares of a fintech start-up. Blockchain and the derived tokenization, will unlock value for a whole range of assets, from existing equities to new types of issues, bonds, property, IP, fine arts and much more. Now STOs seem to be the instrument that will take off in the near future but is still unclear if it will be able to scale and be accepted globally. If not STOs other instruments will rely on blockchain to foster the digitization of companies initiated with the internet back in the nineties.

- *Will blockchain lead the way to reach a more democratic access to capital and investments challenging traditional ventures and banks?*

Following the previous question and answer, it is important to understand how the digitization of assets can challenge existing investment and funding industry represented by traditional venture capital firms, private equity and banks. Blockchain could allow the creation of platforms for the issuance of traditional financial products on a tokenized nature, making it easier, more transparent and cheaper to manage and access these

tools for everyone: on the one hand investment opportunities not normally available directly to savers, and at the same time an innovative financing channel for SMEs, that traditionally find it more difficult to access financial capital. Online marketplaces will include traditional investment products, under the form of security tokens, combined with an integrated issuing and management system, whiles exchange will allow to buy and sell digital assets. Blockchain could potentially solve the problem of accessibility to investment products while offering companies an agile and transparent system for financing innovative projects. The use of the blockchain allows to reduce costs, time and intermediaries in the placement of financial products that are normally packaged and distributed, often in a non-transparent way, affecting negatively on returns.

It is important at this stage to clarify the difference between a cryptocurrency and a security token to avoid confusion and misunderstanding. A cryptocurrency transmits value or allows access to decentralised networks and can be assumed as a payment instrument. A security token is a digital representation of the ownership of a financial asset, such as a company's shares or quotas, a bond or other products. A great advantage of security tokens is their stability, since they are expressed in euros, or other fiat currencies, and do not suffer from the volatility typical of cryptocurrencies, while enjoying all the advantages of using the blockchain. A debate is still open whether public blockchains (*permissionless*) or private ones (*permissioned*) will become the standard choice for these products. A private blockchain, for its own fact of being private and therefore censurable, does not guarantee as much transparency, immutability and security to investors as a public one would do. The public blockchain has unravelled some important barriers to entry typical of the classical financial market and investors can trust a system that disrupts the traditional channels of collection and investment without the need of relying on a third party. These characteristics tend to favour the adoption of public blockchains, but they will face fierce competition and opposition from traditional players that of course are not willing to lose a huge part of their market. However, blockchain-based systems will offer people and companies new levels of access to capital, investment and financial opportunities.

After having answered the previous questions of interest, accordingly to the Von der Gracht methodology, as shown in Figure 34**Errore. L'origine riferimento non è stata**

trovata. , the projections and the related results have been used to the development of future scenarios.

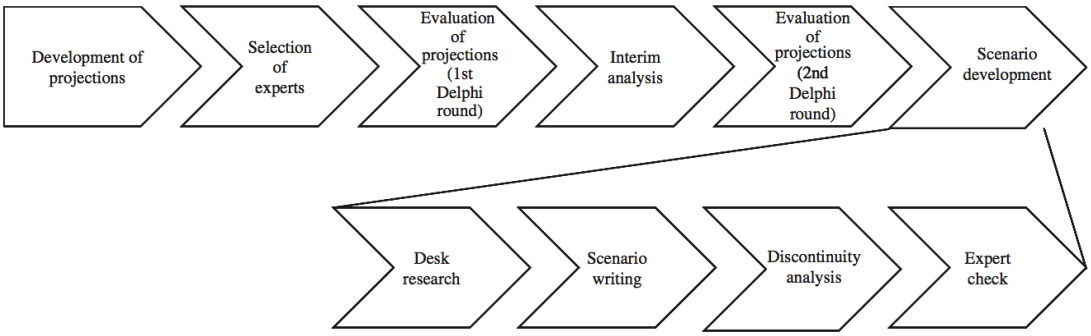


FIGURE 34 - LAST DELPHI STEP: SCENARIO DEVELOPMENT (VON DER GRACHT, 2008)

For the lack of simplicity, it has been decided to sum up all the results through a scheme, considering two dimensions. In particular it has been employed a quite common framework of the literature, using as axes the variables “product changes” and “supply changes”. These four main development scenarios have been completed and analysed at the light of the conducted interviews and of the quantitative and qualitative data gathered through the Delphi survey.

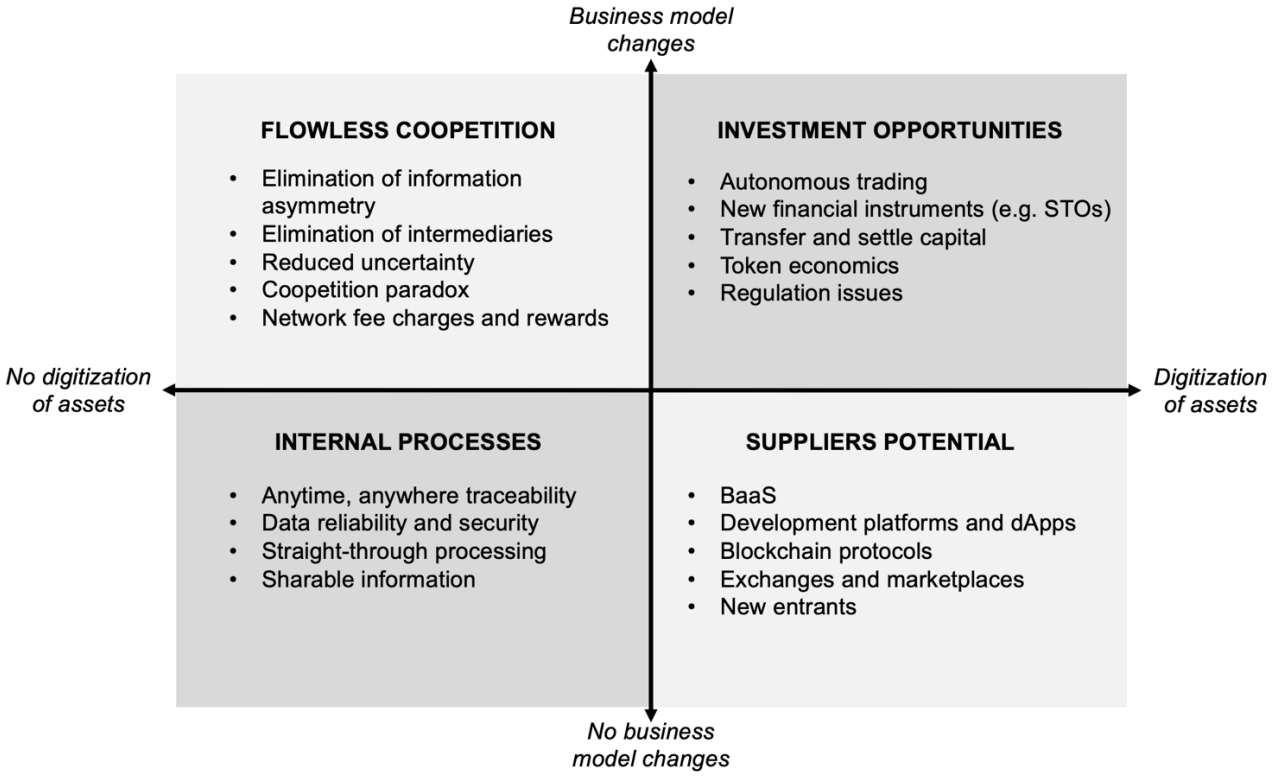


FIGURE 35 - DEVELOPED SCENARIOS FOR BLOCKCHAIN-BASED SYSTEMS IN EU BY 2030

For scenario analysis it is useful to start from the bottom left quadrant called *Internal Processes.* This name was chosen to highlight the absence of particular evolution of the company at a strategic level through blockchain adoption. In this case it is conceivable to use the technology to incrementally improve the operation performances. Indeed, as mentioned in the first chapters, blockchain main and straightforward benefits are to increase traceability of transactions and guarantee their immutability, increase the security of the information since no-single point of failure will be available and rendering it publicly available. All these characteristics adopted on today processes will result in an automation of routine business function, such as settlements and reconciliation, customs clearance, heavy payments, invoicing, documentation, and transactional demands boosting operational efficiency and cost performance. It is therefore possible to define this business strategy as static, characterized by a too short-term vision and focused only on cost reduction.

The top-left scenario shows instead different perspective considering a broader adoption of blockchain, not only for internal purposes, that generates new cooperative business models among different stakeholder, sometimes even among competitors. This is why it

was decided to call it *Flowless Coopetition*. In this case blockchain benefits will aim at generating a more democratic ecosystem in terms of information. Those actors that based their business models on information asymmetry, having access to key information before others, will need to revisit their business models if they want to stay competitive. We are already seeing important incumbents and start-ups taking actions to benefit from these new coopetition models. JP Morgan Chase is partnering together with other banks such as Goldman Sachs and the National Bank of Canada to use a private blockchain platform called Quorum. In this scenario the other main characteristic of blockchain technologies, i.e. the potential ability to eliminate intermediaries arises. All companies and organizations whose value proposition was based on approvals and certification of transactions, such as payments or properties, will need to revisit their model and adapt to this disruptive wave.

The bottom-right scenario, called *Suppliers Potential*, highlights how thanks to the digitization that blockchain could allow, many actors could jump in the market providing solutions to those companies that would like to benefit from the advantages of digitizing their assets, but do not have the means and have difficulties in changing their business models. Those companies would rather outsource the development of blockchain-based solutions and this is why there's a huge opportunity instead for those companies that will generate the ecosystem focusing on a B2B market. There are already protocols that are leaders in the market (Hyperledger Fabric and Ethereum), but new solutions with different configurations will likely be needed to support different industry and use case solutions. Same argument applies for decentralized application that can be built on top of the protocols. Main issues regard the combination of speed, security and decentralization that is hard to achieve, and providers typically focus on one of these characteristics, but these issues are not seen as structural barriers in the long term.

Finally, the last scenario, called *Investment Opportunities,* focuses instead on the combination between the complete digitization of the assets of a company and the new business models that this major change could generate. As already mentioned in previous chapters, the industry is experimenting many ways to facilitate the access to capital. Since ICOs in 2017 proved that new and easier ways to access capital are possible and achievable. Even though, due to their disordered and unregulated nature ICOs ceased to exist they opened the way to a new paradigm that can be proven disruptive. Now other solutions, such as STOs, are being tested, but what will be the

dominant design for these new financial instruments is still unclear. However, the industry might achieve in the not so long term a token economy reaching a sustainable monetization of coins and tokens. Bringing higher degree of freedom to investments will allow both companies to have major investments and funds from different and non-traditional investors, as well as private people to invest on early-stage companies disrupting the roles of venture capitals. Of course such a scenario faces many issues in terms of regulations since leaving to much space for investment opportunities might lead to disastrous outcomes and some boundaries and limitations will be needed.

6.2. Conclusions

In this thesis have been developed four reliable scenarios for those companies that have adopted or are considering adopting blockchain technologies by 2030. The management of a company can use these forecasts as a starting point for the implementation of new strategies. However, the research results suggest that long-term analysis of the blockchain is important since there are too many variables to take into account to anticipate a clear picture of what it might look like in the future. This thesis is useful starting point for orienting oneself ins complex and dynamic environments as well as in the field of technological development in order to reduce the perceived uncertainty. In fact, thanks to expert advice, it is possible to have a clearer picture of the future and the evolution of blockchain technologies in order to identify opportunities and threats. Certain limitations and characteristics of this study must be considered to correctly and effectively take advantage of its results. Scenarios are not specialized in any blockchain technology, what is also an aspect that influenced the experts answering the survey. The main objective of the dissertation is to examine the most disrupting aspects that are likely to occur in the European Union by 2030, with a particular focus on how to facilitate financing, reduce costs, increase transparency and, in general, influencing the business models. From this point of view, the objectives and assumptions presented at the beginning of this study can be considered as fully achieved. However, the research paves the way for a better understanding, as the differences between industries are too large to be analysed in a single dissertation.

CHAPTER 7 - Appendix

7.1. Appendix A – Expert interviews

Interview 1

The first interview was conducted with a Blockchain expert, manager of a research hub of an Italian bank. Involved in managing various projects and initiatives, he mainly works with FinTech startups and has five years of experience regarding blockchain technology.

The interview, having been one of the first, and thanks to the availability proved by the expert in question, had an extended duration of one hour and thirty minutes. He was happy to explain me in detail his vision about blockchain and more specifically about Bitcoin in a 360-degree vision of the entire ecosystem highlighting the benefits and current limits of technology and what future developments may be.

- *Bitcoin Maximalist*. The expert defines himself as a Bitcoin maximalist. Contrary to major statements and opinions, he believes the real innovation is represented by Bitcoin itself and not by the Blockchain. As argument he claims that the blockchain subsists thanks to the monetary and retribution value that Bitcoin gives. Without an attached value it becomes a simple DLT that loses the initial meaning of complete decentralization.
- *Multi-technology*. Blockchain is not a single technology, but a group of already existing technologies (e.g. Hashing, PeerToPeer, Public/ Private keys) merged together and they cannot work properly without an economic incentive (according to Game Theory).
- *Private blockchain*. Private blockchains and DLTs, raised through consortium (e.g. banks), do not represent a disruptive innovation, but they’re simply a move that governments and banks are doing to lead the hype around blockchain to favour them. But DLTs require big efforts being the governance (technological, operational and legal), really complicated. It is difficult for the participants to reach an agreement. Moreover, such a system shoulders the risk of having however a third party managing the software for the actors involved, becoming itself a single point of failure (SPOF).
- *Centralization*. Centralized database and systems have better performances, since they do not require a duplication of effort. Evolution and R&D activities are now

improving blockchain performances, but they are far to reach centralized systems ones.

- *Micropayments*. If right now Bitcoin works for “Permissionless Savings”, meaning that it can be used to store value without asking anyone or the permission of an institution, with the introduction of Lightning Network, it will become “Permissionless Payments”, allowing instantaneous micropayments. Improvements, such as LN, must be made on different layers. Changing the Bitcoin, to introduce a new functionality, causes many disagreements and is hard to enforce a single solution (e.g. Segwit and Segwit 2X).
- Blockchain has mainly two uses:
    - Value exchange (transfer economic value in a secure and permissionless manner)
    - Anchoring (time stamping to notarize time and ownership in an immutable sequence)
- *Bitcoin*. Bitcoin represents the only true blockchain and the one in which the best experts are working. It will survive. All others that have risen and might arise, will have different aspects and probably lose the anonymity and decentralized values with which Bitcoin was founded. But having an anonymous and permissionless currency is of no interest of governments or banks. The complete adoption of Bitocoin is more a political problem rather than a technological one.

Interview 2

The second interview was conducted with the Founder and CEO of a French start-up, previously consultant in a technology consultancy company. The interview had a duration of 35 minutes and the expert has an experience on blockchain of four years. From this interview it has been possible to note that blockchain technology, although present for more than ten years have been really taken into consideration in the last two years and it is now when there’s a real and relevant commitment towards its development.

- *Time to market.* At present, companies investing in the technology are gaining a competitive advantage for the future. The expert believes that is now the best moment to enter in the market and that the first mover advantage will be key to become market leaders in the near future.Most companies though are just investing

in it simply because they fear to be left behind and suffer the threats of competitors, but without having a true commitment efforts are reduced to minimal outcomes.

- Big companies have an easier access to capital to finance R&D activities, while SMEs find it more difficult. Those ones who are really interested in developing use cases for their business must aggregate together and invest in co-development and co-financed activities.
- *New skills.* There is a scarcity of experts and valuable human resources who are really knowledgeable of the technology. Companies and governments struggle to find the right teams and consultancy and moreover the cost of trainings sessions is really high. New skills will be needed in digitization and in particular in the design of blockchain ecosystems.
- *DLTs.* Most of the companies are focusing more on DLTs, because this allows them to keep control and understand exactly data inputs and outputs. With DLTs for companies is easier the analysis of KPIs such as the response of the systems, time needs, access perspective. DLTs will probably continue to be implemented in the future in order to have a decentralized system (i.e. increased security) but maintaining control (i.e. managed by a single party, either the company itself or a third party).
- *Public/ private.* Real blockchain systems will take off for public services and needs that will not only be meant for a restricted community such as a company, but those the most part of a population can benefits from. Examples are the exchange of electricity and money.
- *ICOs.* There has been a lot of hype around ICOs before they had been banned in China. Of course, many were frauds. The fact that now governments are trying to regulate them is a good sign (e.g. France PACTE regulation). Startups will need to prove more that their project is solid and has true potential, ICOs represent a wonderful way to raise money for a project and they will be used more and more. Investors are able to use the tokens they buy in order to use the services. The more spread and use is the start-up, the more the ROI increases.
- *Cryptocurrencies.* At the moment bitcoin is not a currency, transactions are to slow and there are many other cryptocurrencies that allows a faster exchange of value. The implementation of lightning network, once it will be largely adopted, will be a

boost with unlimited throughput and less transaction fee. This might make bitcoin become a currency. The cryptocurrencies that will remain in the near future, will have their value pegged to Bitcoin and will allow security and speed. Completely anonymous currencies (e.g. Monero) will struggle against regulations and governments actions (they might simply claim illegal to buy a certain currency).

Interview 3

The third interview was made to a PhD expert who provides advisory services to start-ups and companies mainly in Switzerland, Great Britain, Portugal and Belgium. The duration of the interview was around 40 minutes.

His experience with blockchain technology is about 6 years. In the interview it was pointed out from the beginning as there is a big hype around blockchain and related topics. The expert notes that there have been many developments in recent years, but many are the limits the technology needs to overcome.

- Technology by 2030 will be improved in many respects, especially regarding user experience and acceptance, but due to regulations and governmental actions it will rather be an incremental innovation and not so disruptive.
- ICOs represent a great potential and he expects their market and relevance to grow. They will be a disruptive and breakthrough innovation for equity crowdfunding (e.g. through the creation of tokens and digitalized ETFs…). Right now not many people trusts tokenized securities and financial products but he expects demand to grow in the next years and thus, real and practical tests to come.
- *Regulations*. He is optimist about regulations and commitment of the European Commission towards the technology and believes, that although slowly, its actions are fostering innovation and helping the adoption of the technology.
- *Money laundering*. He believes that once regulations will be settled, monry laundering actions exploiting the blockchain will not be a big issue. Already with the KYC regulations it is compulsory for all exchanges to get informed about who is buying/ selling cryptocurrencies.

- *Accounting*. The adoption of the blockchain will help the management of corporate financial activities, such as auditing and accounting by saving time and costs in operation activities.
- *Competence*. Great developments of the blockchain will be made by particularly skilled people in this field. One of the great limits is the lack of competent people in this field. By training and teach the blockchain potential in universities and research centres, there will be more confidence in technology and adoption.
- *Service providers*. The number of blockchain service providers specialized in trainings and realization of use cases and proof of concepts will increase.

Interview 4

The fourth interview was made to the COO and founder of a small Italian start-up specialized on improving Bitcoin payments in an enterprise environment leveraging smart contracts. The interview lasted for about thirty minutes. In this case, the expert has been studying the technology for 5 years.

The company focuses on providing payments systems to small local business rather than targeting big companies. They believe that the adoption of the technology should become a need of the community and though they foster a bottom up demand.

- *Cryptocurrencies*. The expert believes in the potential of cryptocurrencies and claims that with regulations and a real commitment by governmental institutions they could be represent an effective substitute of fiat money after a long parallelism of the two coexisting.
- *Competitive advantage*. Businesses who start trusting the technology will have a competitive advantage in the future. Being pioneers is key and once the community will understand easily the potential of the technology the paradigm shift will be inevitable.
- *Smart contract*. The possibility to implement self-executing contracts represents a business model that needs a lot of regulation and implies many legal issues that are difficult to solved. He is positive that in the next year legal entities will adapt laws and regulations in a way that will foster the usage and implementation without risks.

- *Intermediaries*. The blockchain will not eliminate completely third parties as it is often said, but it we will assist to substitution of major actors in favour of third parties that will require less regulations and thus transaction costs.
- *Open Innovation*. Leaving external knowledge to be disseminate in already existing project is an important factor that will enhance adoption and the evolution of the technology. Technology clusters and areas are also an important asset to exploit to favour knowledge sharing.

Interview 5

This interview was conducted with an Italian university PhD researcher and it lasted forty minutes.

The interview in this case was not focused in a specific characteristic of the technology, but I let the expert talk about what he thought it was relevant for the purpose of the dissertation and about his beliefs of the future scenarios.

- *Disruptive change*. The expert underlines how the technology is exponentially evolving after starting smoothly in 2008. It is following a typical s-shaped curve and that by 2030 the changes will be radical and it will be close to the maturity phase, with a restriction of the usage and a standardization that will be visible.
- *Diffusion*. By 2030 almost all digital firms, or firms using digital assets, will have adopted some form of blockchain technology, integrating it into business processes and operations.
- *SMEs.* To date, they struggle to have access to the technology, both because is costly, but also because there's a repulsion by teams and employees that are averse to change and radically change their way of working. Big companies on the contrary are able to create specific teams that are really committed on the technology and are also in charge of sharing their knowledge with the colleagues.
- *New application.* To date the main industry involved is the banking and financial one, followed by supply chain for transparency and tracking of the goods during the lifecycle. By 2030 we will see many use cases applied to various industries, many will fail but many will survive with business models that will provide a positive ROI.

- *Developing countries.* Even developing countries could see a great opportunity in the blockchain, they don't have the barriers related to the attachment of the community to old paradigms, though will be easier for them to adapt rapidly. He would not be surprised to see efficient use case adopted widely in central Africa, as it is happening for land registry.
- *European context.* The blockchain technology was not adopted immediately in the European context. Real interest arose in the last two to three years, with the European Commission understanding that Europe couldn't stay behind the US and the Asian market on the topic.
- *Regulations*. Governments are moving to try to regulate this sector and, in the future, they will make great efforts in this direction.
- *Digitalization*. In the near future digital transformation of businesses will lead innovation. Among the transformation companies will need to adopt, blockchain is for sure one of them that moreover have connection with all other big technological trends such as IoT, Big Data, AR and VR. Those who will be able to seize the opportunity will grow much faster, while others may be left behind.

Interview 6

This interview was conducted with consultant that has been working for three years on blockchain-based project in France. The interview lasted thirty-five minutes.

- *Stability*. The European political context right know doesn't provide a lot of stability and this damages risky and costly initiatives for companies that would like to know more and try the technology. They prefer to invest the capital in more secure investments rather than R&D about a technology that has still a lot to prove
- *ICOs*. The expert believes ICOs have a great potential, but they are rather utopian. Utility tokens represent a solution that is looking for a problem rather than a solution for an existing problem. Right now, start-ups and companies that have valuable ideas and prove to have a sustainable business model have an easy access to capital (VCs, PEs, Crowdfunding). By deciding to launch an ICOs might mean that they have something to hide that normal means to get finance don't agree with.

- *Closed economic environments*. Utility tokens must be proved powerful just in restricted economic environments (e.g. videogames) in which they can be exchanged to receive a particular service, but without having access to global capital markets and exchange that could influence their value.
- *Private blockchains*. Most companies now are investing to find a use case that proves itself to be profitable. They are struggling to find an MVP or a PoC that provides a sustainable positive ROI.
- *Transparency*. One of the main problems of private blockchains shared and manged by different entities is the level of transparency to be provided and the data exchange.
- *Time to market.* Though, this is the best moment to enter the market. There are strong synergies and SMEs can co-invest in R&D activities to break down costs.
- *Infrastructure.* The impact regarding infrastructures will be minimum, on the contrary software implication and changes will require a lot of adaptation in terms of skills, trainings and understanding of the new paradigm.

- *Education*. Company therefore play a major role in education, but also research centers and universities must rapidly include teaching sessions about the technology. Many countries are already moving in this direction, in Europe though, we are still slow.

Interview 7

The seventh interview was held with a finance expert professor, with more than twenty years of experience in trading and that knows about Bitcoin and the blockchain since 2012, when it was something still very hidden and unknown.

The interview lasted about thirty minutes.

- *Speculation*. Since the early days of bitcoin, cryptocurrencies where just seen as a trading game and few were those ones that were really foreseeing its potential. Still, today speculation activity is the main reason to invest and buy bitcoins and other cryptocurrencies. People who gets involved does it willing to become rich in a fast

and easy way, rather than willing to eliminate third parties, have transparency or immutability.

- *ICOs*. In the last two years we have seen the amazing arrival of ICOs and utility tokens. These two instruments have a truly disruptive nature, but as all radical changes they fight against regulations and aversion to change by all stakeholders involved. He is confident that before 2030, the first real applications will be available and that the paradigm shift from a system to another will take place.
- EUs. Europe is running late against Asia and the US that are way ahead of us. It is extremely important that actions are taken by research centres, universities and governments. Actions cannot come just from the private sector, because it will be focused only in finding a solution to a particular business need, rather than providing a broader view.
- *Corporate Financing.* ICOs and the possibility to digitalize company shares as tokens is really interesting, but is facing some legal and regulation issues, such as the asymmetry of knowledge and the rights associated to them

Interview 8

This interview was conducted with a woman project leader of the World Economic Forum who previously worked for the United Nations for more than ten years.

Her major field of knowledge regards digital regulations, justice and cybersecurity, but in the last three years she is also concerned about the implications of the blockchain and how the technology will be implemented in existing ecosystems. She is also often invited during technological events as a guest speaker and the interview lasted around forty minutes

- *Cybersecurity.* Due to her experience in the domain she explained how the blockchain represents a meaningful technology to avoid cyberattacks to sensitive data and digital files. The avoidance of a single point of failure is the main reason blockchain will be adopted in the future, since with cyberattacks becoming more frequent and dangerous, the cost of investments for companies on distributed ledgers will be a must have as a form of contingency budget to avoid the risk. In case of a serious attacks and loss of data, costs will be exponentially higher.

- *Pioneering activities*. By no surprise all pioneering activities, such as military activities to space missions that are dealing with extremely sensitive data are implementing and studying the adoption of decentralized systems to avoid the risks. As for all technology they will be followed by the private sector when the cost will be economically lower and ROI higher.
- *Europe*. Europe is trying to catch up the delay on R&D activities on the technology, but she feels positive on the outcome. It is now the best moment to invest in research and look for useful use cases that will prove themselves profitable and European Commission has all the intentions to do it and to not stay behind.
- *Labour.* Together with the R&D activities related to the blockchain, major efforts must be done to educate the community on the topic. At the moment there's a scarcity of resources able to actively work on it and create real value. Governments should enhance the study of the technology in universities and incentivize it for the private sectors. In Europe some are doing well, while some other are still not conscious of the need (e.g. Italy).

Interview 9

The interview has been carried out visiting the offices of a consultancy company that is, at the time of writing, working on an IoT project for a client in the automotive industry. The project manager allowed me thirty minutes of interview with him and then I had the opportunity to stay with two consultants that were happy to show me in detail the project and answer my questions for another fifty minutes.

- *IoT.* By 2030 billions of objects, services, goods and almost everything we use daily will be possibly connected with each other. This will mean that trillions of data will be processed and transferred in order to let the communication flow smoothly and lean and all this data will need a safe and secure architecture to rely on.
- *System architecture.* Blockchain characteristics could represent a good solution to certify transparently and safely the data between two objects, but at the moment few of them have a performance that could sustain such amount of data.

- *Supply chain.* As a product moves along an assembly line or between suppliers, IoT sensor will update the status on the blockchain without the need of human intervention.
- *Inventory management.* For inventory accuracy and management IoT and blockchain can collaborate to make suppliers and clients communicate digitally and automatically, and this will lead to a better planning.
- *Bitcoin.* Bitcoin blockchain is too slow and doesn't have a performance that allows a fast transfer of data. Even with the implementation and adoption of Lightning Network, the architecture is too complex and if a change is needed rapidly, we cannot rely on the community to reach a decision fast. Other attempts have been made (e.g. Iota), but he believes that private blockchains among companies, interested in letting their asset to communicate, in this case are a more suitable solution.
- *Machine to machine.* By 2030, he believes we will see already real cases of machine to machine payments, such that personal finance of a person will be managed by drones, fridges, doors or cars. Regulations will be needed, but we're not far from the time in which humans will lose degree of control on their purchases, spending and habits with machines and AI deciding it for us.
- *Incremental*. Thus, the blockchain in the case of IoT will simply complement traditional technologies incrementally and adapt to the emerging needs of the businesses.
- *Disruption.* Disruption is not represented by the blockchain itself, but by the business models that will arise that will lean on it and other technologies such as artificial intelligence.

Interview 10

This interview was conducted with a project manager of an investment bank part of the BPCE French group and pioneer in the participation of R3 and Corda initiatives. The

interview lasted around thirty-five minutes and the expert has an experience of seven years regarding blockchain.

The interview in question was a source of several new insights into possible future scenarios and was mainly focused on the consortium environment and how banks are adopting the blockchain to decrease costs of operations.

- *Consortia.* In theory consortia should bring all competitors of an industry together to gain competitive advantage on those who are not part of it. But hurdles arise when deciding which data need to be shared. It has been years already that R3, Corda and Enterprise Ethereum Alliance are present, but they struggle in gaining wide adoption.
- *Collaboration.* Consortia provide a collaborative environment, but competitors are still averse to this kind of mindset in which they could get value by sharing information with competitors.
- *Legal.* From the legal side also, consortia face many problems. Even if transaction are faster and reduce costs, there are the costs of approving all the system legally and this means a lot of physical papers to be signed.
- *Security Tokens.* Bringing real assets into the blockchain could democratize the accessibility to them, but this to faces many challenges. They are subject to securities regulations as normal bonds and stocks, but they will be traded easier, reducing frictions and generating more liquidity. But as well as consortia, security tokens will see the opposition of long-established stakeholders that have no interest in democratizing the industry.
- *Smart contracts.* Smart contracts could also enable the programming and automation of security tokens. For example, a loan tokenized could automatically make payments without the need of a bank.

Interview 11

The eleventh interview has been with the CEO of a start-up operating in Europe and now willing to expand globally. The expert allowed me one hour interview and showed a lot of interest in the dissertation making suggestions and giving me important insights.

- *Blockchain and DLTs.* The expert strongly points out the difference between blockchain and decentralized ledger technologies. The former being the real revolution and decentralized system able to disrupt many industries, while the latter simply a reaction made by incumbents to try to control the evolution of the technology. DLTs will not represent a disruptive innovation, but they will simply be implemented to reduce some operational costs, without leading to a change of paradigm. Though, they represent a strong and real trend because governments and incumbents have a strong interest in them, while prefer to slow down public blockchain that are a real threat for them.
- *Immutability.* With DLTs moreover, the immutability feature that a public blockchain could allow, is not achieved since there are some third-party actors controlling it and a centralization is always possible. Even blockchains like the Ethereum one has seen cases of centralization, a DLTs cannot be marketed as an immutable, transparent and trustless system. Thus, he believes that a legal recognition of documents on DLTs could be only achieved with strong regulations made ad-hoc and with cooperation between governments and corporation, forming lobbying systems that will self-legitimate their DLTs.
- *ICOs.* After the hype in 2017 nowadays they do not present a good strategy for a start-up to get financed. It is a very useful instrument, but still very immature. The expert explained me the concept of a DAICO and sent me the material published by Vitalik Buterin on the topic to get informed. DAICOs represent an instrument for investors to control the flow of money the start-up they are financing has access to. According to the results achieved, a certain amount of funds will be unlocked from the fund, if promises are not satisfied investors can disinvest without losing all the funds.
- *Money Laundry.* The expert also explained me how ICOs can be used for money laundry purposes and that these phenomena must be regulated and avoided to make the innovation grow. If a person has a certain amount of money coming from illegal activities, she can decide to start her own fake project and launch an ICOs.

In an anonymous way finance the project with the money, buying the tokens and in this way cleaning them.

- *Decentralized Exchange.* The expert positively sees the development of decentralized exchanges. BISQ, founded by Manfred Karrer is now working even though at very low levels. Decentralized exchanges will lead to a complete confusion and financial anarchy, but the expert believes that the benefits will overcome the drawbacks.

Interview 12

This interview was conducted with an experienced lawyer and notary, member of the italian minister of the economic development, a panel of blockchain experts elected by the government to define the national strategy. The interview in question was a source of several new insights regarding regulations and the European situation at the date of writing.

- *Pardigm shift*. Bitcoin and consequently all blockchains that followed, represent a paradigm shift. As all paradigm changes, it has found unprepared legislators and regulations.
- *Regulators*. Those in charge of finding a way to develop the blockchain ecosystem, must first understand that old laws are not suited anymore, but first of all understand the potential of the technology. Most of them are trying to adapt existing regulations, but this is not possible.
- *Natural law*. Like most famous laws in physics (e.g. gravity) Bitcoin follows its laws and rules, not issued by nature, but by its algorithm. This cannot change though, it is immutable. Only thing that could change is how people uses bitcoins.
- *New laws*. In order to educate people and to build trust around blockchain is imperative that legislators find new rules that will respond to the challenges and needs that the blockchain is bringing in order to foster its development.
- *Illegal activities*. The percentage of bitcoins used for unethical and illegal activities is minimal and negligible. There are not any statistics that prove the contrary.
- *VAT.* In all 28 member states of the European Union, bitcoins, and other cryptocurrencies, are considered as voluntary basis payment method and thus, not dubject to VAT.

7.2. Appendix B – Literature projections

TABLE: BLOCKCHAIN FUTURE SCENARIOS OF LITERATURE

Number	Projection	Source
1	Auditors will be involved in auditing the technology associated with blockchains, as well as retrieving transactions from them. Moreover, because the software needed to maintain transactions in a blockchain is complex, auditors must provide assurance related to the system's control environment.	Lorraine Lee, Kirk Fiedler, Richard Mautz
2	During completeness testing, auditors should be able to trace transactions from the blockchain to the financial statements.In addition, a combination of tools related to data analytics and artificial intelligence could assist with fraud detection through pattern recognition across the entire transaction population.	Lorraine Lee, Kirk Fiedler, Richard Mautz
3	Internal auditors will be responsible for recommending controls associated with organizational processes that use blockchains, including the acquisition, protection, delivery, and enhancement of the information assets stored within them.	Lorraine Lee, Kirk Fiedler, Richard Mautz
4	The use of blockchain can complement the IoT with reliable and secure information. This has started to be recognized as mentioned in [79], where blockchain technology is identified as the key to solve scalability, privacy, and reliability problems related to the IoT paradigm.	Ana Reyna, Cristian Martín, Jaime Chen, Enrique Soler, Manuel Díaz

5	IoT can join forces with blockchain in many scenarios. Almost all traceability applications can benefit from the inclusion of IoT devices, for instance, sensors that are attached to the product to be traced can provide information during its distribution.	Ana Reyna, Cristian Martín, Jaime Chen, Enrique Soler, Manuel Díaz
6	Blockchain could be a powerful candidate to make the smart city concept a reality. The concept of the smart city is based on smart IoT devices that can work autonomously. Blockchain can increase the autonomy of devices since it eases interaction and coordination by providing a distributed open ledger where devices can query trusted information with reliability.	Ana Reyna, Cristian Martín, Jaime Chen, Enrique Soler, Manuel Díaz
7	Thanks to Blockchain will be possible to build a sharing economy where each IoT asset can be rented securely and quickly without the need for any authority.	Ana Reyna, Cristian Martín, Jaime Chen, Enrique Soler, Manuel Díaz
8	Smart contracts connect intelligent devices with insurance policies. Through these contracts the devices can order maintenance and insurance payment can be automated. With the inclusion of Oracles to report events, claim handling can be automatically handled.	Ana Reyna, Cristian Martín, Jaime Chen, Enrique Soler, Manuel Díaz
9	In the newly proposed blockchain embedded credit system, SMEs with low-risk and high-quality could display their credibility and risk class through information distribution. They are more likely to access bank loans even if they are not able to provide collateral.	Rui Wang, Zhangxi Lin, Hang Luo

10	The alleviation of information asymmetry and credit rationing problems can be achieved through decentralized consensus and information distribution among all participants.	Rui Wang, Zhangxi Lin, Hang Luo
11	The risk sharing mechanism involving government, banks and firms, will not only make the establishment of such an innovative system possible, but also create risk pool for the blockchain based lending and borrowing.	Rui Wang, Zhangxi Lin, Hang Luo
12	The tamper-proof and algorithmic executions characteristics of the blockchain technology may also enhance the reliability of conventional credit system and contractibility on contingencies that were difficult to contract traditionally	Rui Wang, Zhangxi Lin, Hang Luo
13	Banks are investigating, but don´t want to invest too much money in a potentially hyped technology. Most conventional institutions don´t know much about it yet. Developments to date suggest that the blockchain technology bears promise but that there is still a long way to go for implementation.	Haiss Peter, Andreas Moser
14	However, not only security would be improved by implementing the blockchain technology but also costs and the duration of processes would be reduced	Haiss Peter, Andreas Moser

15	Perceived advantages of DLT are a reduction in cost and duration and slimmer procedures. Disadvantages are especially relating to slowness and the lacking legal framework	Haiss Peter, Andreas Moser
16	most DLT applications would require first solving various technological, operational and regulatory challenges in terms of scalability, interoperability, standards and governance, personal data protection and digital identity management to ensure fair and secure access to data stored on a distributed ledger.	Haiss Peter, Andreas Moser
17	only the large global players that can afford costly basic research have a good understanding of the concept and opportunities at hand.	Haiss Peter, Andreas Moser
18	information campaign e.g. by supervisory or regulatory bodies to disseminate proper innovation technology into regional banks might greatly help	Haiss Peter, Andreas Moser
19	Smart contracts using the blockchain make contracts possible where the parties involved do not have to trust each other. This may change the process of taking out a loan massively. They could make loan payments safer and faster, because they take action when conditions are met and therefore reduce the risk of errors	Haiss Peter, Andreas Moser

20	In addition, several existing long-standing businesses and professions will probably no longer exist. These losses will be a result of structural changes caused by firms using Blockchain or a similar system	Kurt Fanning et al.
21	Blockchain could save financial institutions at least $20 billion annually in settlement, regulatory, and cross-border payments costs	Kurt Fanning et al.
22	Blockchain to issue and transfer the equity shares of closely held companies on the exchange's private marketplace. Replace the current paper certificates system, with a lowering of cost and a gain in speed of having the initial public offering.	Kurt Fanning et al.
23	Using a Blockchain the accounting entries between two trading partners can easily be compared while maintaining data privacy. This solution could significantly reduce the reliance on auditors for testing financial transactions	Kurt Fanning et al.
24	Storing patient data securely and accurately is a major concern of all health care providers. It is strongly possible that the public sector will become a large user of Blockchains.	Kurt Fanning et al.

25	Several municipalities are looking at Blockchains for recoding property transactions. Other municipalities are examining using Blockchains for tamperproof voting records and vehicle registries.	Kurt Fanning et al.
26	Blockchains are being examined as a means for handling loyalty-points programs. Others are examining Blockchains as being an effective way to validate information about luxury goods. Similarly, vendors of tickets to events are looking at using Blockchains to help prevent fraud.	Kurt Fanning et al.
27	entrepreneurship by giving entrepreneurs new ways to raise funds and engage stakeholders. Enable entrepreneurs to raise funds directly from investors across the globe, democratizing access to financial capital; Give investors opportunities to invest in earlystage projects across the globe, democratizing access to investment opportunities;	Yan Chen
28	innovation by giving innovators a new way to develop, deploy, and diffuse decentralized applications Help innovators build user communities by rewarding early adopters and active users with blockchain tokens; and Blockchain tokens and the potential democratization of entrepreneurship and innovation 573. Allow innovators to build developer communities by rewarding developers with these tokens.	Yan Chen

29	Bitcoin is unstoppable and will continue to rise in the years to come	Yan Chen
30	Bitcoin has no intrinsic value and is just a modern day pyramid scheme	Yan Chen
31	Fundraising: Entrepreneurs can raise funds directly from investors across the globe. Entrepreneurs can raise funds from the public through initial coin offerings.	Yan Chen
32	Investment: Average investors can have almost equal opportunities to invest in early-stage ventures across the globe through blockchain tokens. Investors enjoy almost immediate liquidity with blockchain tokens.	Yan Chen
33	Community Building: Platforms can reward early adopters with tokens, compensating for the lack of network effects. Platforms can reward early complementors with tokens, compensating for the lack of network effects.	Yan Chen

34	Open-source: Open-source projects can fund their continued development through token sales. Open-source projects can share their success with core developers through tokens. (not by asking for donations but by issuing blockchain tokens)	Yan Chen
35	ICOs are reshaping fundraising and democratizing access to financial capital, allowing promising projects to get funded more easily.	Yan Chen
36	By democratizing access to opportunities, blockchain tokens are disrupting traditional venture investments	Yan Chen
37	Blockchain tokens are a mechanism for wealth sharing. They can be used to incentivize early adopters and developers, facilitating adoption and community building.	Yan Chen
38	Blockchain is said to have the potential to disrupt the way the global financial system works and change the nature of investment	Cynthia Weiyi Cai

39	The Blockchain 2.0 stage involves the addition of intelligent contracts, enabling Blockchain to be used in financial or economic markets, and also extend to stocks, bonds, futures, loans, mortgages, property rights, intellectual property and other contracts.	Cynthia Weiyi Cai
40	Furthermore, they note that blockchain is a breakthrough technology capable of changing the back-office handling of transactions in current financial services, such as settlement, regulatory and cross-border payments	Cynthia Weiyi Cai
41	By reviewing cutting-edge blockchain applications in Korea, Yoo (2017) finds that blockchains applied in the financial sector are expanding into settlement, remittance, securities and smart contracts and payments between banks based on a closed (private) distributed ledger	Cynthia Weiyi Cai
42	Similarly, Guo and Liang (2016) propose that payment-clearing systems and bank credit information systems can serve as appropriate scenarios of blockchain application as the blockchain technology can be used to solve issues such as lack of mutual trust, high transaction cost and fraud.	Cynthia Weiyi Cai
43	Mills et al. (2017) further identify both the opportunities and challenges facing blockchain implementation in the area of payment, clearing and settlement (PCS) processes such as cross-border payments and post-trade clearing and settlement of securities.	Cynthia Weiyi Cai

44	Zhu and Zhou (2016) propose that crowdfunding could benefit from blockchain as it has the potential to solve the trust issues related to the registration of shares and the management of funds collected by crowdsourcing, and to facilitate mechanisms of corporate governance that would enable small, distributed shareholders to exercise control over a funded company.	Cynthia Weiyi Cai
45	Tapscott and Tapscott (2017) believe 'blockchain technology will have profound effects on the nature of companies: how they are funded and managed, how they create value, and how they perform basic functions such as marketing, accounting, and incentivizing people'.	Cynthia Weiyi Cai
46	They foresee that new technologies including cloud computing11 and blockchain will 'enablecorporations to outsource overhead, crowdsource innovation, and eliminate middle managers and other intermediaries, thus freeing industries such as accounting, commercial banking, and even music to consolidate assets and operations'	Cynthia Weiyi Cai
47	Scott et al. (2017) share a similar view, arguing that blockchain technology may help develop organisations that seek to build social and solidarity-based finance	Cynthia Weiyi Cai

48	Nowinski and Kozma (2017) show that blockchain technology may disrupt existing business models in three crucial ways: by authenticating traded goods, disintermediation and lowering transaction costs.	Cynthia Weiyi Cai
49	Luther (2016a) argues that cryptocurrencies will remain ‘niche monies’ and the only possibility to replace existing currencies exists in countries with very weak and poorly managed currencies. However, cryptocurrencies may be used in areas that do not necessarily require widespread adoption.	Cynthia Weiyi Cai
50	Berentsen and Schaer (2018) conclude that cryptocurrencies such as Bitcoin have the potential to develop into an interesting investment and diversification instrument (a new asset class).	Cynthia Weiyi Cai
51	Mai et al. (2018) assess what drives the value of Bitcoin. Through a blend of machine-based methods and explanatory econometric analysis, they find that social media sentiment affects Bitcoin prices.	Cynthia Weiyi Cai
52	Luther (2016b) proposes that the value of using a particular currency depends on the number of other users who are ready to transact in that currency.	Cynthia Weiyi Cai

53	A review of crowdfunding research suggests that this FinTech innovation does not eliminate the need for financial intermediaries; rather, it creates a substitution of traditional intermediaries	Cynthia Weiyi Cai
54	Compared to traditional banks, one of the main advantages of crowdfunding is that it has fewer regulation requirements and therefore fewer transaction costs	Cynthia Weiyi Cai
55	blockchain can also be used by banks to reinvent (i) their processes and (ii) the products they offer. Blockchain can eliminate the necessity of intermediation in some areas, bring new forms of intermediation and, at the same time, reduce the layers of traditional intermediation.	Cynthia Weiyi Cai
56	Another example is that blockchain can also help banks to reduce the layers of intermediation to improve the payment process. By having a distributed ledger with a history of transactions that is visible and transparent to all relevant parties, banks could avoid having to use a third party to reconcile and settle transactions. This interbank blockchain can reduce the layers of intermediaries and therefore speed up the process and reduce associated costs.	Cynthia Weiyi Cai

57	Blockchain opportunities are derived from the technology's capacity to operate tokens that grant access to an alternative portfolio of financial services that the incumbent financial system may be unable to satisfy.	Guillermo Jesús Larios-Hernández
58	countries with limited banking infrastructure and, naturally, cash dependence could use blockchain technology as a safe network to hold and transfer money, especially for lump-sum wage payments,	Guillermo Jesús Larios-Hernández
59	blockchain entrepreneur to seek opportunities to design financial credit services with the potential to improve existing lending practices, accompanied by context-aware value proposition that develops around security, efficacy, and efficiency.	Guillermo Jesús Larios-Hernández
60	Cash-to-digital conversion takes place if users see advantages in terms of protection from theft, rapidity, and accessibility	Guillermo Jesús Larios-Hernández
61	The financially excluded could find new opportunities in alternative financial service platforms, especially in the least-developed economies where corruption and lack of trust separate people from formal services.	Guillermo Jesús Larios-Hernández

62	Institutional change can facilitate new forms of blockchain and context-aware entrepreneurship for alternative financial-inclusion solutions.	Guillermo Jesús Larios-Hernández
63	We find that the probability of an ICO's success is higher if the code source is available, when a token presale is organized, and when tokens allow contributors to access a specific service (or to share profits).	Saman Adhamia, Giancarlo Giudici, Stefano Martinazzi
64	ICOs favor open-source project development and decentralized business, generating a built-in customer base and positive network effects (Giudici & Rossi-Lamastra, 2018).	Saman Adhamia, Giancarlo Giudici, Stefano Martinazzi
65	ICOs,: the token mechanism allows funders to create a secondary market for their investments, while conventional equity-based, lending-based or reward-based contracts are essentially illiquid.	Saman Adhamia, Giancarlo Giudici, Stefano Martinazzi
66	The availability and quality of the information regarding prospective ICO projects matters to potential contributors and positively affects the probability of a project's success (white paper + open source code)	Saman Adhamia, Giancarlo Giudici, Stefano Martinazzi

67	The structure of an ICO matters to contributors and can have substantial effects on the campaign's ultimate success (token presale + bonus schemes)	Saman Adhamia, Giancarlo Giudici, Stefano Martinazzi
68	Token characteristics matter to contributors and can have different and significant effects on an ICO's probability of success (access to services or used as internal currency + governance or profit rights)	Saman Adhamia, Giancarlo Giudici, Stefano Martinazzi
69	ICOs have significant potential in funding "decentralized" cross-country teams of developers, favoring open innovation. Although some countries have banned ICOs, others are clearly signaling the "borders" that should not be trespassed, and will probably move toward regulating token offerings to avoid fraudolent behaviors.	Saman Adhamia, Giancarlo Giudici, Stefano Martinazzi
70	Blockchain technology's disruptive potential may be viewed through a similar lens – where the benefits of an open, decentralised architecture exceed the transaction costs of operating and maintaining such a distributed network, activity will be decentralised.	Michael Casey, Jonah Crane, Gary Gensler, Simon Johnson, Neha Narula
71	blockchains cannot achieve scalability – i.e., overcome the capacity constraints described above – without sacrificing either decentralisation or security	Michael Casey, Jonah Crane, Gary Gensler, Simon Johnson, Neha Narula

72	The presence of network effects suggests that the economic benefits of a blockchain application would increase at an accelerating, non-linear rate as the number of users increases.	Michael Casey, Jonah Crane, Gary Gensler, Simon Johnson, Neha Narula
73	for the top ten banks alone, blockchain technology could reduce infrastructure costs by 30%	Michael Casey, Jonah Crane, Gary Gensler, Simon Johnson, Neha Narula
74	Because interbank payments are large and relatively less frequent, the benefits of increased transparency, reduced liquidity constraints and faster settlement may outweigh the limitations imposed by capacity constraints of DLT	Michael Casey, Jonah Crane, Gary Gensler, Simon Johnson, Neha Narula
75	To reduce the massive duplication inherent in existing KYC checks, banks and other traditional service providers are looking to become ‘KYC bureaus’, with DLT potentially standing in as the cross-institution source of proof.	Michael Casey, Jonah Crane, Gary Gensler, Simon Johnson, Neha Narula
76	a shared ledger may enable a shift to near real-time clearing and settlement, eliminating the need for reconciliation of duplicative records. This might significantly reduce the counterparty risk – and associated capital requirementS – inherent in those delays.	Michael Casey, Jonah Crane, Gary Gensler, Simon Johnson, Neha Narula

7.3. Appendix C – First Round experts main arguments

No.	Arguments
1	***Low probability***
	Lot of people still don't get what Internet is today
	Understanding the potential of blockchain will be key to accept and globalize the use of the technology
	Blockchain is the machine room, people will know to drive, but not how to construct
	All people will use tech based on blockchain, because it comes with their smartphone, but the majority of the people will be uneducated about the underlying tech (also not necessary)
	Blockchain will become embedded in most our day to day activities and will be taught as an elective (at least) in schools/universities
	Just like Interne,t people do not really know the technology behind it, but this is not relevant for its application.

	Impact is high because education means that it would become a legitimate career path, you also would have laws that takes decentralised services and/or property into account. However just like with previous revolutions: steam engine, finance, airplanes, electricity, laser, internet, cars, I expect most will only have a shallow understanding
	People will have a degree of knowledge about what a blockchain-based system only if it's required or interesting for them
	High probability
	New ideas about how to use this technology
	Assuming further consolidation across industries, large enterprises will increase their efforts and resources aimed at leveraging new technologies to avoid being left behind or outcompeted.
	Awareness and knowledge will improve innovation
	It has to be true, the need of Blockchain knowledge will be obvious. Many school already add Blockchain program to their masters.
2	***Low probability***
	US, China and Russia might take a lot of advance on UE, UE could take much longer to regulate in order to develop blockchain
	already too late for that; leader will be China, U.S., India

	APAC countries will be leading the way, not Europe.
	Lack of clear regulation, lack of business attractivity, gafam will remain leaders of this ecosystem
	EU processes too cumbersome and bureaucratic
	More than half innovative product or startup around DLT are founded and running in US and east Asia
	I see that unlikely due to bureaucracy and lobbying. I expect smaller countries like Switzerland or Dubai would be the hub though Estonia leadership looks promising. Having Europe as a leader would probably have high impacts on ethics and transparency especially on industries that are often criticised like agriculture and healthcare.
	EU regulators always lag, engineers will be based mostly in europe in "Digital nomads hubs" such as Berlin, CPH or Lisbon but all companies they're contractors for will be incorporated elsewhere
	High probability
	We are working hard to get involved EU through many Projects and Implementations in EU-Countries: many FOOD Supply chains,
	Legal framework will develop technologies and applications
3	***Low probability***

Cryptocurrencies are still perceived as an issue so I see them behind the application of blockchain per se.
Blockchain-based technologies are mostly used to avoid middlemen, increase transparency and decrease server-centric philosophy
Security through obscurity is very much ingrained in society, also I'm pretty sure this threaten a lot of "costly" position so i expect a lot of fighting back and lobbies.
High probability
Because that is exactly what they do
Cost effiency is driving most of the business, combined with security it is a killer argument
Will happen even earlier; only blocking point: energy consumption
Changing the rules in our Professional and Private Life. "We have the
Following the initial missteps of cryptocurrencies, especially in light of their adoption ad merely speculative investments, blockchain technology will be increasingly used for non-financial applications.
Money love speed, and Blockchain provide speed at cut cost.

4	***Low probability***
	Politicians and law makers have close to no idea what we are talking about and they prefer a safe conservative approach
	will take some time, but could happen around 2030
	whenever there was a new technology, there was always a way to hack it. despites it's "unhackable unlikely scenario" there will be a potential threat for it somehow.
	Typical issues tied with bureaucracy and pushing for mass adoption when having to rely on political leadership
	Research and enhancement are currently doing on this new born technology
	Personal Identifiable Information management is still not harmonized after 5+ years of discussions between all states and it is apparent that those with decision power do not know what can be done with PII or even with just social engineering. Throw in blockchain and they will be completely lost.
	data protection is not a tech issue, it's a user education issue and users don't care.
	High probability
	Digital identity is one of the best Value added by blockchain in my view

	It will take due time, but it will happens. Consumers will make the decision for the changement!
	This will be the real revolution. Own our data is the winning bet.
	Regulators are already working on that.
	Our lives are going to be more and more digitalize. And I truly think Blockchain can help on managing that.
5	***Low probability***
	Fostering is unlikely, allowing more realistic. The impact is high mainly from an empowering standpoint - acceptance of regulatory bodies will improve mood and stimulate entrepreneurship and innovation, but passively
	current approach is 'too centralized and prescriptive'
	The competition will do the job. Banks are envy of bitcoin decentralized system. Insurance are proposing blockchain-based offers just to stay in the innovative competition
	EU regulators are years behind any other juridictions, Blockchain tech is by definition above borders, it's a winner take all situation and EU have no chance of being competitive nor attractive
	High probability

	It would be enough time to achieve ita nd properly governed and shared to the lower level in each EU Country
	Clear law framework will allow better ways of working for companies
	EU is already moving in that directions.
	We will probably have grants and task forces around that, but I fear the money will be drained by big corporations and "design-by-committees"
	It has to be regulated and standardized.
6	***Low probability***
	Blockchain aims to eliminate intermediaries, there is no point in using a Blockchain and also keep them
	I do assume than many intermediaries will be extinct
	Unless a new technology comes and replaces blockchain
	Blockchain based system will be put in a category (bank, insurance, payment system, ...) and will be required to comply with its classification.
	I think Blockchain will be incorporated into our traditional system.

	High probability
	Surely new rules and regulations are going to be created, implemented for a correct adjustment for this time objective.
	On one side, lobbying from financial intermediaries to protect themselves. On the other hand, the necessity to identifiy a legal entity to be controlled by the regulators.
	Either you change , either you die. Look at financials traditional system vs cryptoassets industry
	Healthier, better, competition might lead to better services at a discount.
7	***Low probability***
	in 2030 there won't be any focus anymore, but broad adaption
	As mentioned earlier, unless new technology appears and make blockchain obsolete
	The approach can have the biggest impact on the community
	There is more to do far beyond fintech

	Entrepreneurship would probably be focused around lifestyle in Europe, there haven't been as many lifestyle startups (fooding, sports, transport, holidays, coaching, meditation, yoga, ...) as in the past 2 years.
	I don't see a real focus on credit. Basically Blockchain will be approached differently. I think we are really limited because people are afraid of changing their business model. I hope they will realize.
	High probability
	owning your credit score and knowing how to improve it, may grow overall SME activity
	it will achieved ethically and operationally
	New sources of funding to allow worthy companies to grow faster
8	***Low probability***
	Gradual implementation rather that total overhaul seems more likely but also required to succeed in future scenarios
	Most people will have the same model with blockchain incooporatws
	High probability

	they've already dedicated TEAMs inside their Groups
	The technology can not be stopped and every business need to adapt.
	The real added value of Blockchain is there. We have to truly make the change
9	***Low probability***
	AirBNB, Uber, Netflix only have intangible assets
	depends on regulation, if it's cheaper, faster, easier and possibly a way to attract liquidity sure, if we don't have a healthy legal framework it's just adding a layer of complexity to a already stressful process.
	High probability
	It is already starting, working on different projects, the advantages are obvious
	As TE-FOOD (BIG GROUP in ITALY) we are involving through the TFD tokens the Foodchain stakeholders. it works properly!
	Tokenisation allow higher liquidity and a bigger market.

	Blockchain is the internet 3.0. The best players are those who constantly up to date
	Easier, cheaper, speed
10	***Low probability***
	Blockchain has a huge potentiel for all sectors and industries.
	boundaries for cross-boarder regulation in the E.U.
	It's 11 years from now, Blockchain will be widely used. Especially for the auditing and financial industry in which they are already in place today.
	I don't think that blockchain is silver bullet for these problems, however, it might happen because of blockchain hype
	High probability
	Traceability, transparency, security, less frauds, correct seizing of the capital markets.
	Blockchain will create new ways of working, new ecosystems, new models of doing business.
	EU, big companies and Countries are supporting the above trend.

	Either if states get stronger or weaker, blockchain can help (state against government and vice versa)
	Trust is a costly process. They will be reduced
	May major banks ad corporate are usig or offer blockchain-based technologies
	Due to compliance and regulatory constraints, tracing transactions is highly demanded and this is very costly for financial institutions. Also several actors like Swift for transfers, Clearstream and Euroclear for global custody are charging banks a lot for their services and they also want to remove the middleman.
11	***Low probability***
	Too automatic process in this area can't work
	Regulation barriers
	High probability
	It will be even more relevant in the Food ecosystem.
	Reduced opportunities for security breaches

12	***Low probability***
	ICOs and STOs will become more professional. VC funding through token is manageable, but mostly some kind of collateral will be needed
	The market is not made by suchers (not all at least)
	Seems unlikely, but my knowledge here is limited
	Worthy start ups will be able to find money in a faster and easy way
	Someone needs to carry financial risk. There will be collaterals: in fiat, in real estate. What can happen is new categories of collateral emerging like "royalties" as collateral for an artist for example.
	Very hard to achieve, it'll need a strong reputation system or a lot of KYC process.
	High probability
	It's already like that: ico
	Think so, but we truly need regulation. I have been their working for icos and believe me it is not perfect.

13	***Low probability***
	The regulators will not allow transfer of ETs on unregulated markets.
	What is an exchange private marketplace? Either we have a public exchange or OTC trades.
	High probability
	More efficient, takes out intermediaries
	Hail to a paperless and tamper proof future
	Blockchain is new value exchange mean. And smartcontracts are replacing many legal traditional processes
14	***Low probability***
	There will be something new
	With the current growth of STOs and once legislations are passed, then maybe yes

	ICOs have beee used to compensate for a lack of business model sustainability and will only be used to supplement other methods of financing in the future
	ICOs are dead the way we know them
	I think bootstrapping will be much more common. Blockchain will lower barrier to entry to infrastructure including servers (like Amazon Web Services did) and payments.
	They won't be ICO, ICOs are dead
	STO will be the format
	High probability
	ICOs will become a method similar to VC funding. Stos will become normal, there it will be quite strict
	In my opinion this will be the only way
	Already there in France, but still optional and limited to useless "utility tokens"
15	***High probability***

	This must be the way to solve so many cumbersome processes
	I hope with all my heart this will be the case
	DAOs are rising and will dominate the market
	Yes BUT not on layer one, same as now, most trasactions are done by debit/credit cards and are settle on a different layer between banks
	Easier and cheaper.
16	***Low probability***
	Private Blockchain do not provide any sort of guarantee to the public, they are a complex way to describe decebtralized databases
	Possible, but I hope more for decentralized systems
	Private and Public implementations available through many reliable sources
	A step in the right direction and more realistic than assuming multiple big, public blockchains. Sometime excessive democratic decision making can be counterproductive

	Public blockchains must be real evolution
	The hope is to have a public european infrastructure for most applications , with the possibility for privates to choose between a public or private infrastructure
	Regulators will never allow full privacy for users
	High probability
	Control, trade secret, non-disclosure agreement
	I think so, for a company a private Blockchain is definitely more approachable than cooperate with a public one.
17	***Low probability***
	Cryptos willl grow from here, but the implementation of blockchain in businesses will be exponential
	blockchain is for transactions a "revolutionary" technology like it was internet for the communication
	In the future public blockchains could face major changes in the consensus model, what could alter the evolution and applications cryptocurrencies could have

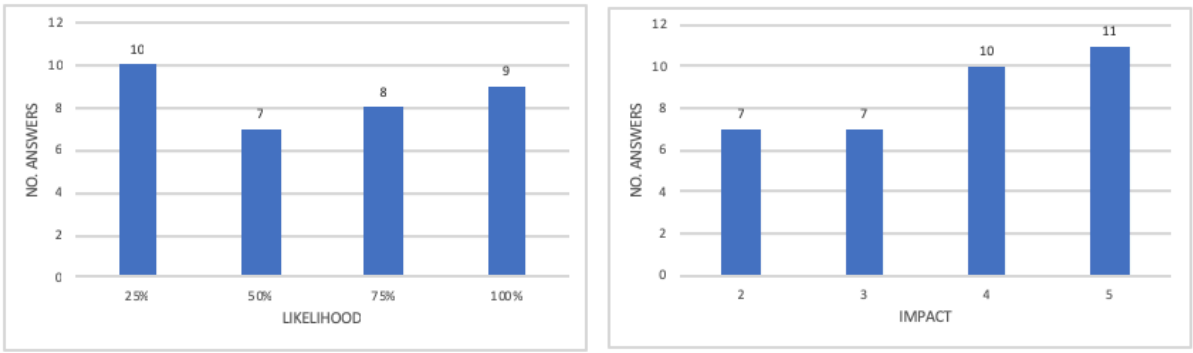
	the energy impact will be a big issue in the future and the change of consensus model could alter the scenario for public blockchains
	States and publics organisations will embrace Blockchain-based technologies for providing public services... by transfering values and goods
	Crypto currently is speculation not investment.
18	***Low probability***
	The general public has to jumps through hops to buy bonds at the moment (compared to shares), this would increase liquidity and funding options to companies. However I expect banks to fight teeth and nails to retain their privileges under the guise of protecting consumers
	High probability
	already becoming reality, see the bitbond token fully regulated in Germany
	it will be an application of the many financial instruments and tools
	But it doesn't mean companies will do so
19	***Low probability***

	I don't see blockchain changing the scale of donations compared to existing solutions like Patreon.
	High probability
	It's already happening
	this will be the next step of development
	Read the success of Imogen Heaps's latest music release. I imagine that on a large scale
	Different business models should be created
	Because one the main philosophy of blockchain technology is to give-back power to people
20	***High probability***
	Working on bonds, real estate, intellectual property already
	Smart contracts are the most intuitive and most logical use of blockchain technology.
	They are still studying on these issues

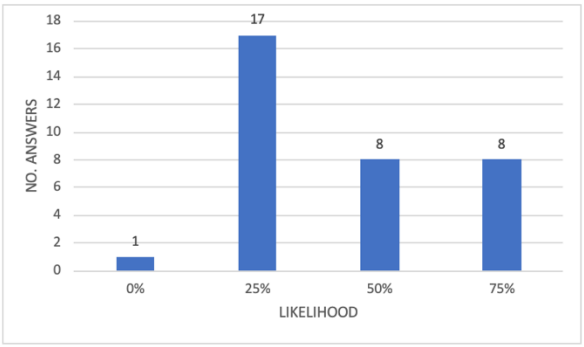
	This evolution has already started.
	People take-back power by skip or avoid middlemen-based systems. Smartcontracts will be more transparent and reliable because we know can easily access the source code
	Cheaper, more transparent, instant

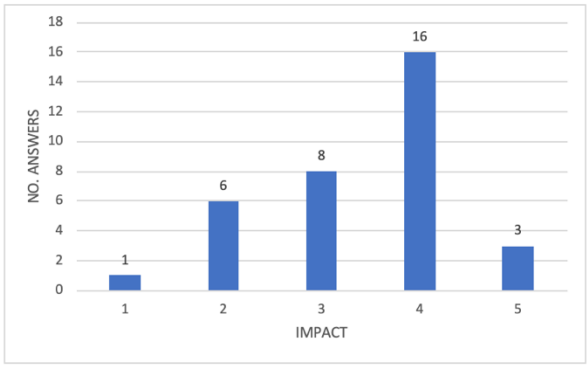
7.4. Appendix D – First Round quantitative data summary

PROJECTION 1



PROJECTION 2





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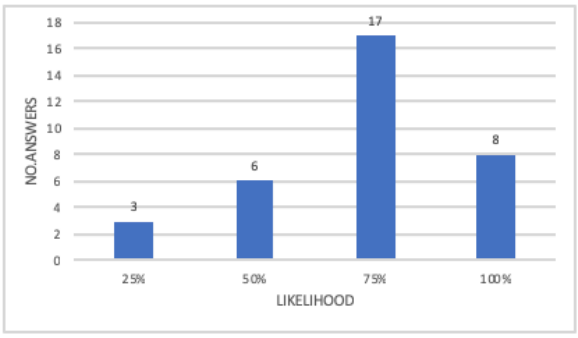

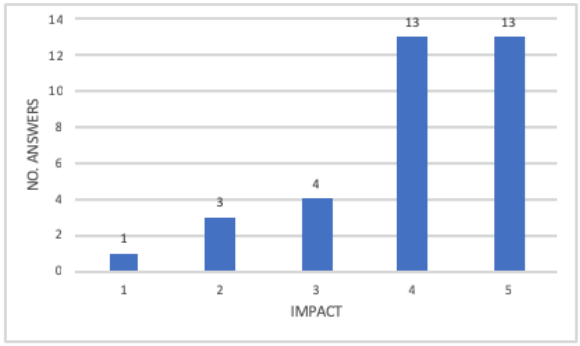

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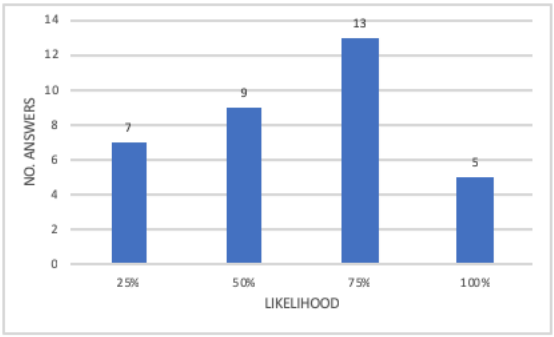

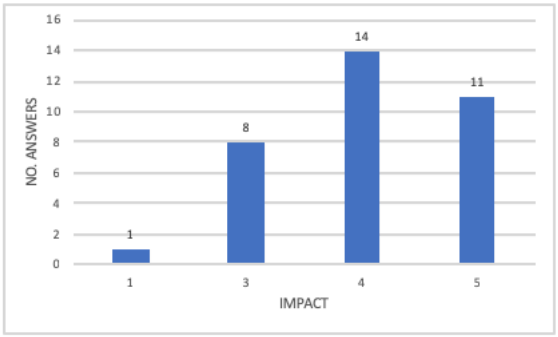

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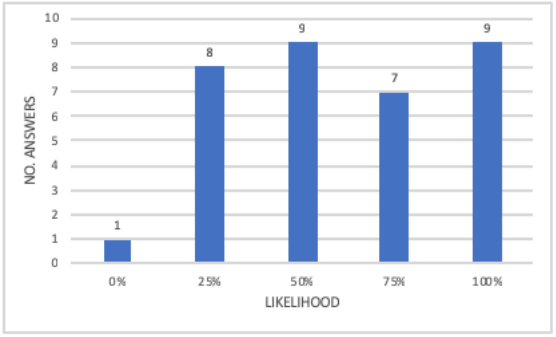

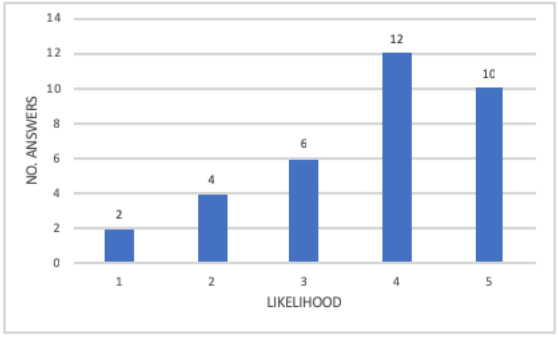

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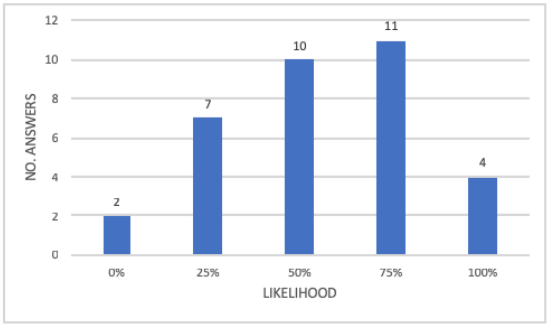

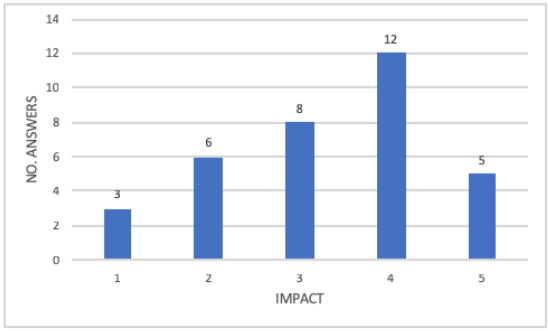

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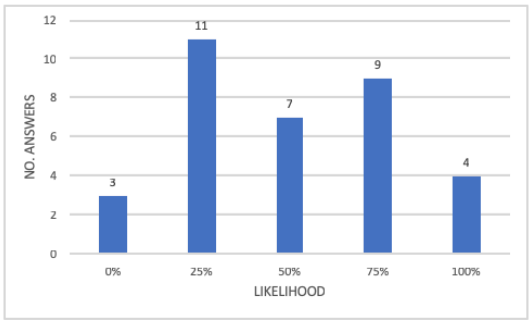

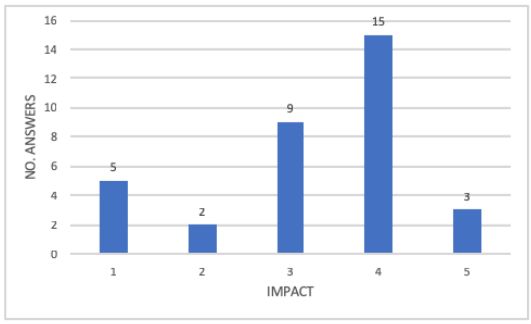

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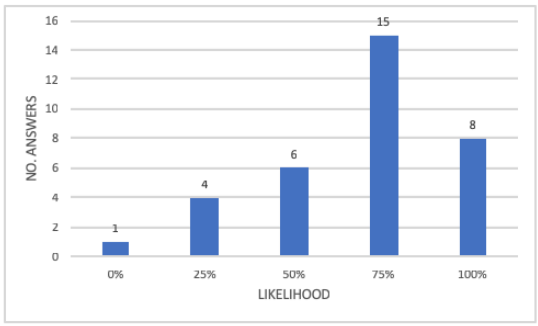

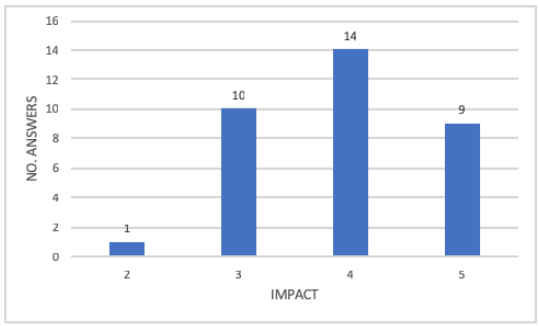

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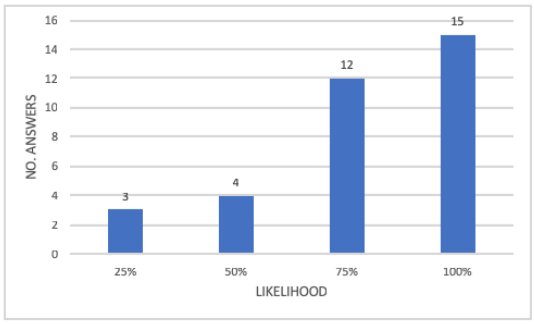

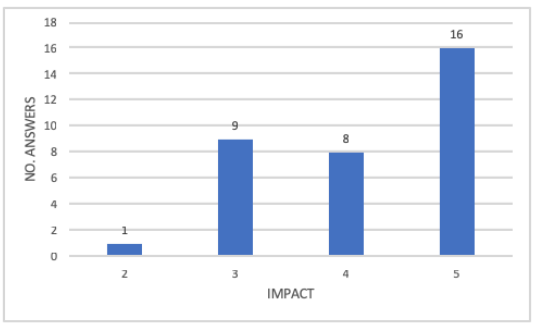

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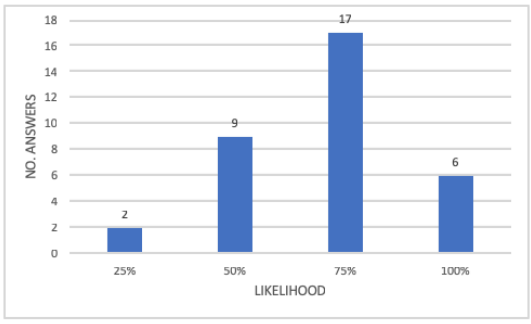

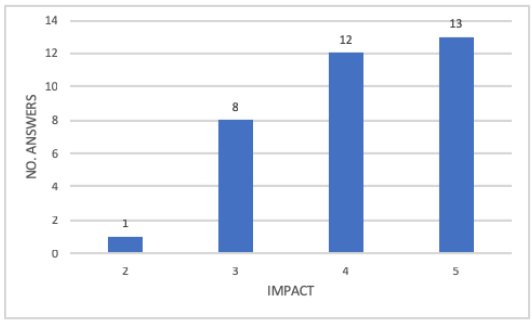

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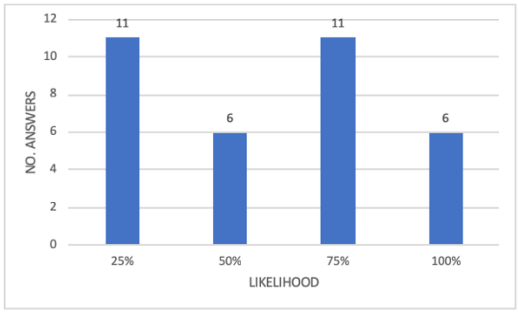

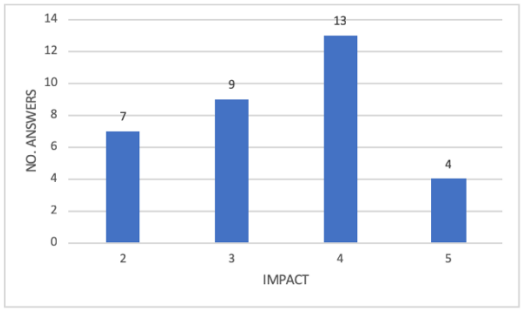

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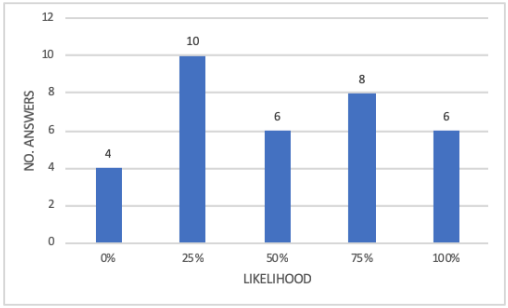

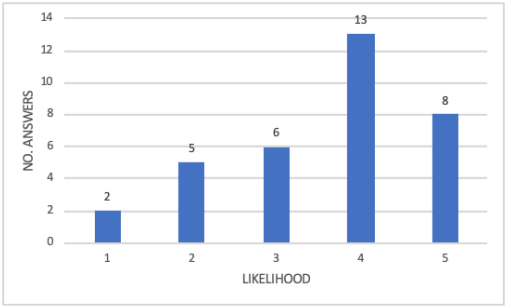

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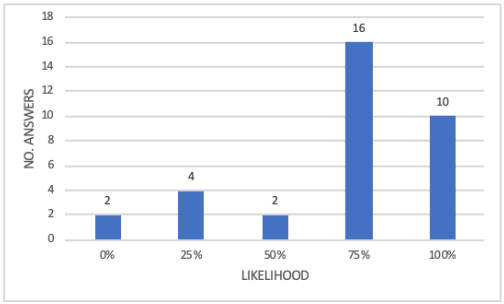

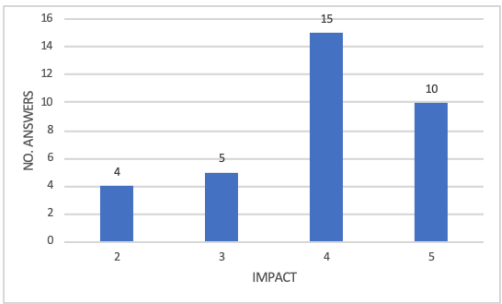

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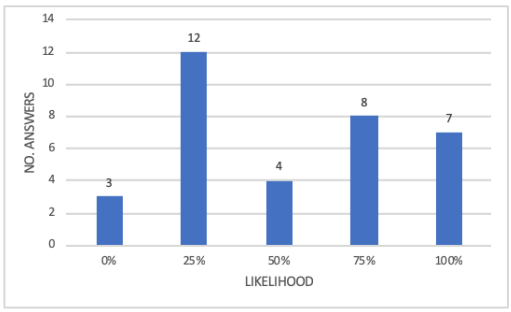

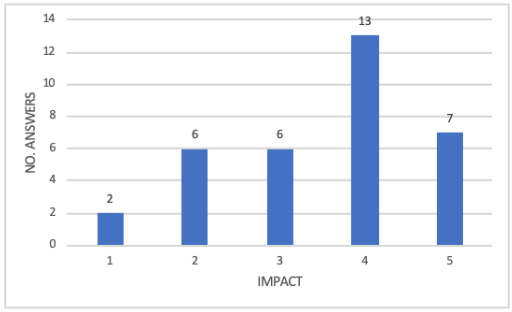

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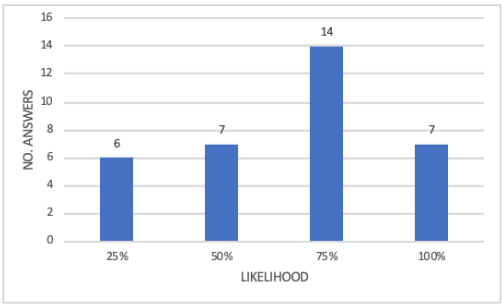

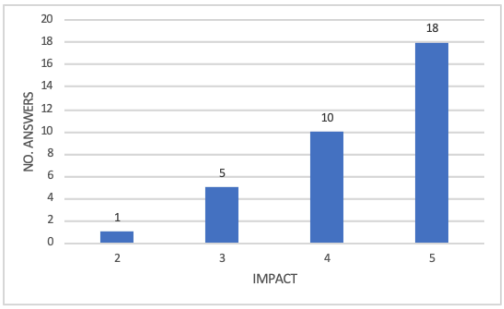

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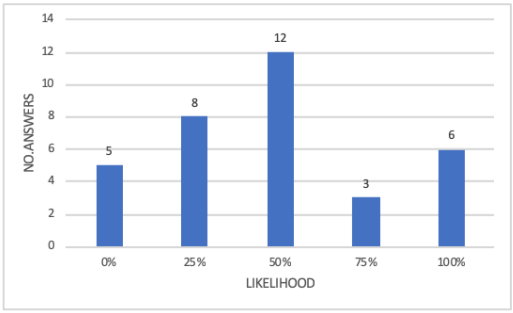

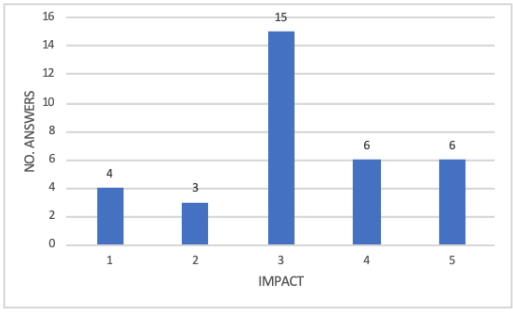

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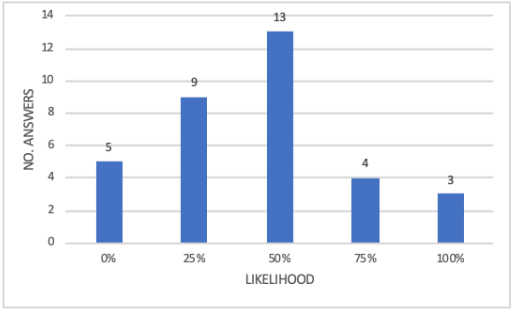

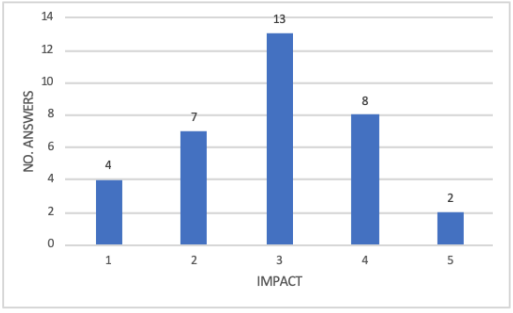

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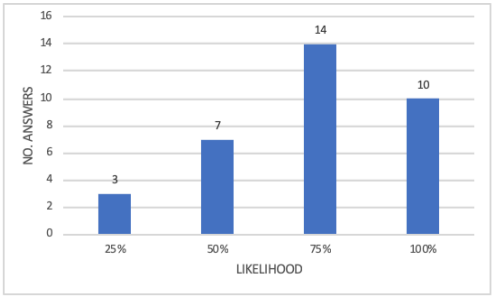

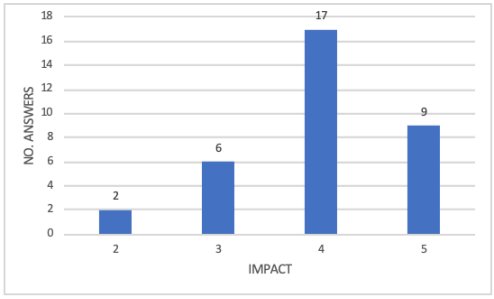

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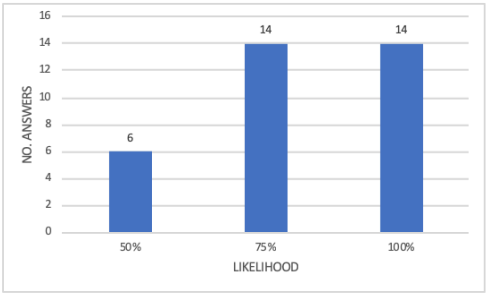

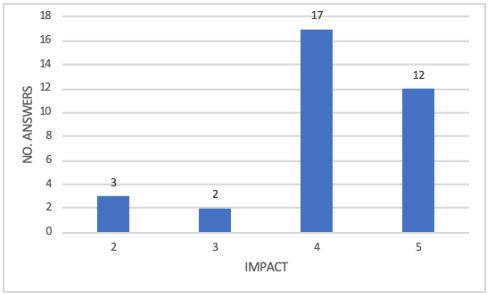

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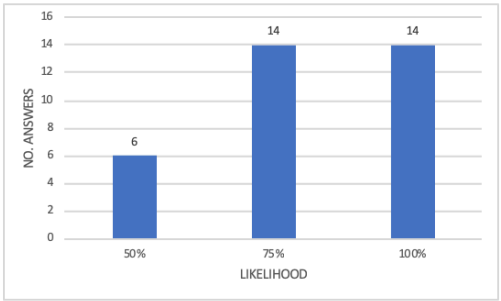
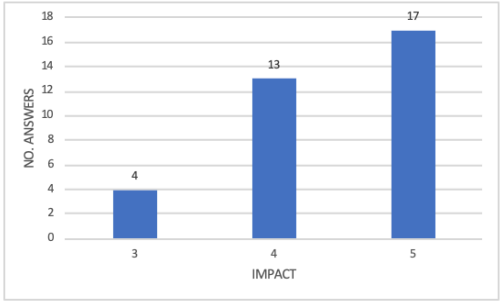
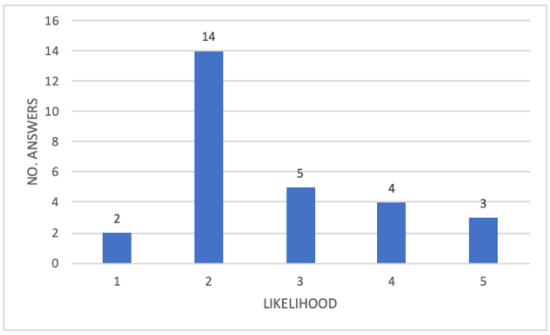




7.5. Appendix E – Second Round quantitative data summary

PROJECTION 1



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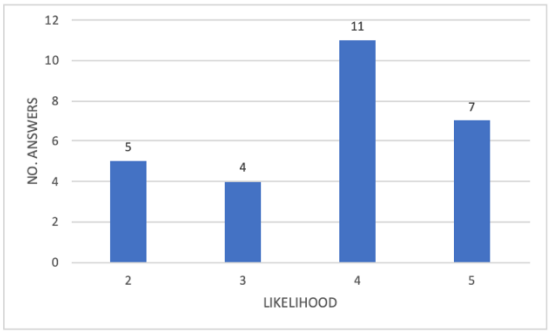

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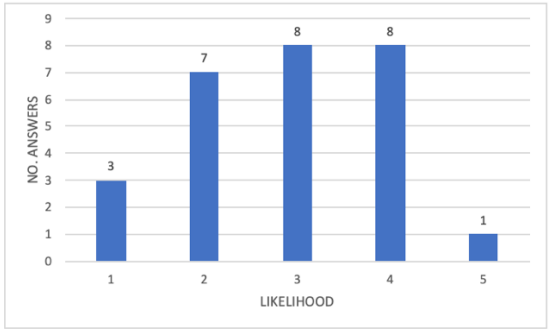

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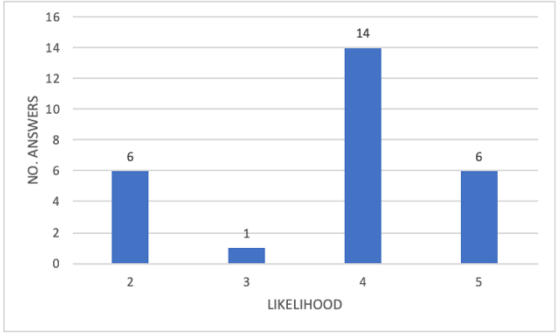

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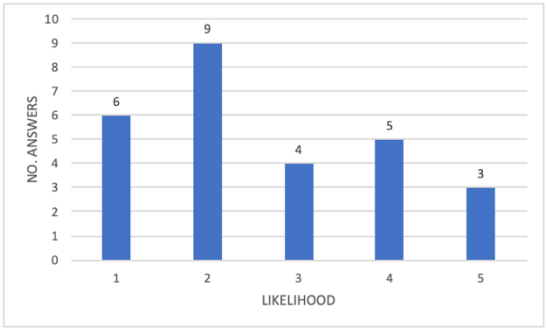

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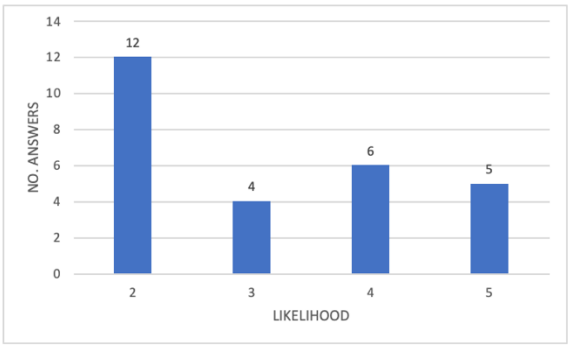

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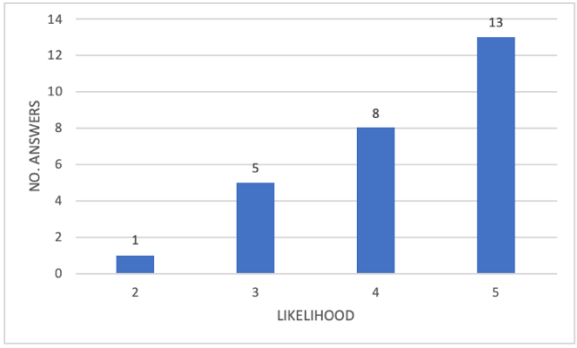

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