POLITECNICO DI MILANO

Master of Science in Management Engineering

Blockchain for traceability: real use cases from agri-food industry

Student:
Colocci Nicola

Supervisor: Daniel Trabucchi

Academic Year 2020/2021

Abstract

Since 2008 blockchain received an increased attention, because its capabilities were promising not only for the financial world, but also for many other industries. One of the he most prominent application beyond finance, is to pursue transparency on the supply chain. An increasing number of companies are implementing blockchain for traceability of goods, especially in the agri-food domain where customers press companies to have more information on products they consume. However, there are few real use cases of blockchain for the traceability and this lack of empirical evidence is a barrier of adoption: companies are worried to realize a blockchain in their traceability systems due to the doubts on how to benefit from it. Implementing a Blockchain for traceability of product comes with high costs and firms want to see a clear pictures before engaging in it. Thus, the aim of this work is investigating on real use cases in order to understand the reasons to a blockchain for the traceability of goods and how to benefit from it.

Abstract (in italiano)

Dal 2008 la blockchain ha ricevuto una maggiore attenzione, poiché le sue capacità si sono dimostrate promettenti non solo per il mondo finanziario, ma anche per molti altri settori. Una delle applicazioni più importanti al di là della finanza, è quella la trasparenza sulla catena di approvvigionamento. Un numero crescente di aziende sta implementando blockchain per la tracciabilità delle merci, specialmente nel settore agroalimentare, dove i clienti premono le aziende per avere maggiori informazioni sui prodotti che consumano. Tuttavia, sono pochi i casi d'uso reali della blockchain per la tracciabilità e questa mancanza di prove empiriche previene e aziende dall' adottarla: quest' ultime sono frenate dal realizzare una blockchain per loro sistemi di tracciabilità a causa dei dubbi su come trarne vantaggio. L'implementazione di una Blockchain comporta costi elevati e le aziende vogliono avere un quadro chiaro prima di coinvolgersi in questi progetti. Pertanto, lo scopo di questo lavoro è indagare su casi d'uso reali al fine di comprendere i motivi per l'implementazione di una blockchain per la tracciabilità e come trarne vantaggio.

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Executive summary

Blockchain and Distributed Ledger Technologies in recent years. Thanks to the hype and the notoriety generated by the huge increase in value that the Bitcoin cryptocurrency has achieved in recent years, Blockchain and Distributed Ledger Technologies has gained momentum in the recent years. Beyond Bitcoin, this technology has the potential to be disruptive in many different industries, from government to supply chain.

For this reason, academics, practitioners, and companies around the world are conducting studiesand experiments to understand how to fully exploit the potential of this new technology. Supply chain management seems one of the prominent domains where blockchain technology could be applied, since traceability and transparency are among the core values of this technology. The agri-food Domain is particularly affected by traceability issues, since consumers are demanding more transparency on the product they consume, and companies want to fill this gap towards them.

Therefore, the objective of this paper is to provide insights into the state of the art of blockchaintechnology by identifying ongoing applications to understand how this can help companies to build effective business and build a competitive advantage. Beyond the hype, the works aims to offer a more practical understanding of how blockchain technology is and will disrupt thecurrent business processes in the agri-food Domain.

Literature review and research questions

A review of scholarly research on blockchain technology in the business literature has been performed to investigate the current knowledge about Blockchain and Distributed LedgerTechnologies and to outline what is missing and which are the themes that have not yet been discussed.

The sector most analyzed is the financial sector, as it offers important insights into how

this technology can improve business processes and speculative opportunities related to the use ofBitcoin cryptocurrency. However, new emerging topics are emerging such as business topics, social and ethical concerns, and supply chain management. Among such domains, supply chain transparency in the agri-food industry is crucial, since it could create value for many different stakeholders, including consumers. These firms are receiving pressure from their consumers, since they want to know more about the provenance of their product, how they are made, and which steps do they pass through before arriving at their hands. For this reason, blockchain seems to be the enabling technology to reduce the different risk that are connected through the provenance of products, namely: financial, social psychological and physical a risk (Montecchi 2019). Therefore, firms that establish product provenance and transparency through the supply chain may have a competitive advantage.

However, implementing a blockchain is not easy, since there are many barriers of adoption (Saberi 2019):

- Intra organizational barriers: these are the set of barriers that are created within the organization coming from company's internal activities.
- Inter-Organizational barriers: in this kind of barriers there are external actors, who we can more generally identify as partners that could provide an obstacle to the implementation of BC for a traceability system.
- System – Related Barriers: these barriers are linked to the implementation of technological tools required for blockchain
- External barriers: This category introduces challenges coming from external stakeholders, industries, institutions and governments.

The number of studies is growing rapidly, but most of them focus mainly on technological aspects and how specific sectors are influenced by technology (Feng2016, Wang 2019, Zhao et al. 2018). Despite so, this, empirical studies are very few, in fact there

is no research based on practical experience and real projects, just as there are no studies that analyze technology from a broader perspective and investigate how it affects the value creation.

The aim of this paper is to provide insights based on empirical research, aiming to fill the current gaps in the literature. Below are presented the research questions:

RQ: What are the benefits of implementing a blockchain as a traceability system?

Methodology

To answer the research questions listed previously an inductive qualitative research based on multiple case studies has been used. According to Edmondson and Mc Manus (2007), theory-building research using cases typically answers research questions that address "how" and "why" in unexplored research areas particularly well. In this case, the work wants to understand why a food company should implement a blockchain traceability system and how it could leverage this asset to create business value from it under different perspectives, namely B2B, B2C and system value.

This type of methodology has been chosen for several reasons, for instance:

1. It is highly descriptive, it emphasizes the social construction of reality, and focuses on revealing how extant theory operates in particular real examples (Eisenhardt, 2007).
2. It especially appropriates in new topic areas and the resultant theory is often novel, testable, and empirically valid.
3. Most of blockchain project have been constituted in the last 4 years, so there is little knowledge on the topic.

Regarding the research method, this research has predominantly used direct interviews to companies which has already implemented blockchain as a traceability system.

Interviews often become the primary data source because they are a highly efficient way to gather rich, empirical data, especially when the phenomenon of interest is highly episodic and infrequent. All the interviews were semi-structured and the underlying reason behind this choice is straight forward: firstly, they are very useful when collecting information on a high level of scope such as the one of the theses. Secondly, when it is not possible to design a list of pre-codes because only little is known about the specific area, and this is the case since as it is emerged in the literature review there are almost no researches trying to address such concerns and most of the application are almost novel.

To conclude, to reach coherence among the sample, all the companies and experts that where interviewed come from the agri-food domain. On the other hand, in order have a wider and a more complete perspective, the interviews were performed on different actors coming from different step of the supply chain. Here brief recap of the respondents and their characteristics:

Organization	***Organization business field***	***Organization business role***	***Interviewer role***
MZBG	Beverages	Producer and Seller	Head of Northern Europe area
FoodChain	IT Solutions	Technology provider	Project Manager
Bofrost	Chilled product	B2C door to door seller	Head of Marketing
Lateria Valtellina	Diary products	Producer	Marketing Manager
Trufflemarket	Truffles	E-Commerce platform	Founder
Chocofair	Chocolate	Consulting Firm	Coordinator
Almaviva	IT solutions	Technology provider	Solution architect
Consorzio arancia rossa IGP	Fresh food	Consortium	President
Pietro Coricelli	Food	Oil producer	CEO
Pastificio Mancini	Food	Pasta producer	Head of Marketing
Pralina	Food	Producer	Marketing Manager

Results

After the gathering the data, they were combined to perform within and cross-case analysis. First, each case was singularly investigated, to understand the main characteristics of each company; then, a cross-case analysis was performed, to compare among different cases, and to answer the research question. Since the objective of this section is to provide a summary of the results here only cross case analysis is going to be presented. Within-case analysis provide a rich and complete understanding of every single use case, but the discussion in this section may be out of scope.

Cross-Case analysis

Reason to implement a blockchain:	*Enhance customer relationship*	*Differentiation*	*Overcome traceability standards*	*Operations efficiency*	*Create a unique BM*	*Unique possibility to meet certain trac. levels*	*Proof product quality or peculiarities*
Foodchain	SME	SME	SME	MNC			SME
Bofrost							
Pietro Coricelli							
Pralina							
Chocofair							
Mancini							
Latteria Sociale Val.							
Trufflemarket							
MZBG							
Rouge							
BASF							

Almost all the company primary objective when they choose to implement a blockchain was to enhance the relationships with the customers. It was mainly a communication issue, since they want to achieve a direct contact with the customer towards the product, having a place in which they could show transparency on the

work they did. Moreover, it was a way also to differentiate from competitors: blockchain is a novel technology, scarcely adopted, and by doing so they want to add a new feature to the product that competitors do not have. Being niches products, they are chosen by customer who makes a conscious choice. Regarding the choice is the blockchain technology, according to most of participants it was the only technology enabler which was able to guarantee the satisfactory level of information they want to deliver up to the customer and that was the main reason for which it was chosen. Companies wants to overcome standard traceability standards imposed by the law, since in most of the cases they were not in line with customers' requests: companies do huge efforts to design effective and qualitative production process, thus they have interest in showing them , even if by the law it is not strictly requested To conclude, what is interesting in this analysis is that many companies from the companies has peculiar or quality product, so blockchain technology seems to suit very well when the company urgers to proof their superior product value to the its stakeholder.

Impact on consumers

Benefit towards customers			
	Increase trust in the product	*Customer loyalty*	*Acquire new customers*
Foodchain			
Bofrost			
Pietro Coricelli			
Pralina			
Chocofair			
Mancini			
Latteria Sociale Val.			
Trufflemarket			
MZBG			
Rouge			
BASF			

Despite most of the implementation of these blockchain projects are novel and companies do not have enough data to understand the impact of the introduction of blockchain, some of them immediately response from customers. Due to their peculiarities and reasons, they were able to evaluate the impact on the application on the blockchain for traceability systems. Several measurement methods where used, some more empirical (customer service and interviews among companies' employee) some other more analytical (structured surveys or sentiment analysis on social media). Even customers seem not to be fully aware of blockchain characteristics, according to many participants awareness is increasing and is some cases the firms could measure an increase in trust towards the product and enhanced loyalty. Customers who already choose some brand for their peculiar characteristics are willing to know more about

what confers such product the value: having a full transparency on the production process and the supply chain it acts as a guarantor for an even more conscious choice than the one that was already made. Now consumers know what happens from A to Z, this allows them to become even more attached to the brand. Moreover, for some of them (e.g. trufflemarket) blockchain technology was determinant factor that lead customer to choose the company instead of competitors. What emerged from that analysis is that the trust in the product could be linked not only to the traceability of blockchain, but on 4 main variables that also affect the willingness to know more about the product, namely:

- Knowledge of blockchain technology
- typology of product
- familiarity of the customer towards that product
- familiarity of the customer towards the production process

Impact on B2B

Impact on B2B					
	Open new business line	*Increase redditivity*	*Enforce B2B relationships*	*Impact on resellers*	*Impact for export*
Foodchain					
Bofrost					
Pietro Coricelli					
Pralina					
Chocofair					
Mancini					
Latteria Sociale Val.					
Trufflemarket					
MZBG					
Rouge					
Basf					

Impact on reseller

Having the possibility two show data information and quality control on the product is appreciated for the reseller. The reason could be different: one could be associated to the fact that they are looking for innovative product and interesting from the customers. According to many participants (Pralina, Mancini, Latteria Sociale, MZBG, foodchain) the resellers knows that customer request on food traceability is increasing, and this is also proven by data (IBM Morning Consult European Food Responsibility Study). For this reason, retailer evaluate positively having such traceability systems and firms benefited from that (e.g., more shelf space (MZBG), new retailers acquired. Another major issue is that implementing a blockchain for the traceability can give an indelible proof of all the processes that a product passes and in some case, they are determinant for the value of the product. For example, to declare baby food you need to have certain parameter or in a fresh or frozen product it is essential that it respects the whole cold chain.

Enforcing B2B relationships

In this case alignment is a key variable. Among a supply chain there are often different actors, for example producer transformers, packers and so on. Implementing a blockchain towards the supply chain force all the participants of the network to align to the standards of the focal firm. Despite it could be a cost for the other business actor, it brings advantages from both side: the focal firm is able to closer monitor its business partner since it has the complete information on what the other partner is doing. The partner take advantage from the fact that once this system is implemented, the focal firm has less incentive to change supplier.

Increase redditivity

For some categories of products having a blockchain that can guarantee the origin and the quality process that a product had submitted can guarantee a premium price for the business actor. Regarding the quality process this is the case for example of Risochiaro, since rising mills recognize a premium price to see all the quality standard for the rice. Regarding origins, there are products on which the value is heavily affected by the provenance of the products (e.g. truffles, Pistacchio di Bronte, Arancia IGP) and there are numerous fake agents which tries to counterfeit the product. Sometimes there are protection consortia as the Arancia Rossa IGP, which role is to control the inbound and outbound flow of the product, to detect If there are inconsistencies. By the way, consortium is not infallible and numerous frauds are committed every year. For example, taking into consideration Arancia Rossa 17.7% of declared IGP oranges are irregular. For this reason, buyer recognize a premium price for guaranteeing the provenance. Companies recognize this premium vaulue and are willing to pay more for product which origins and processes can be certified.

Impact for export

Even if it is not a standard, there is an increasing trend in paying more and more attention to blockchain traceability, especially for those products that are “made in Italy”. This because a product to be declared “made in Italy”, according to Italian law, it must have the latest transformation made in Italy. So, a tomato that come from Norway transformed in Italy and then sent to US can be considered made in Italy. For this reason, international buyers are paying more and more attention to the provenance of the product and being able to proof with blockchain the whole traceability of product is rewarded by e the international partner. This was also found by Rouge, Pralina, Foodchain and Trufflemarket

Open new business opportunity

In this case the three examples are isolated one by another, but it is still valuable to present them. The first is the case of a of a rice mill, tracing a particular method to produce rice managed to enter the baby food market, managing to demonstrate that the selenium level was below a standard level. The second one is Gelateria Marchetti, which partnered with Caffe San Domenico to create the first tracked ice cream and the third was Pralina which created two new business opportunities: the first was that were invited to participate in the Florence tourism exchange precisely for the application of the Blockchain and how this can connect to the story of the territories being aspects, the tourist and the agri-food one, that can interact with each other. The second was the implementation of the technologies to open to private label the opportunity to certify their production.

Impact on brand and ecosystem

	Impact on the perceived image	*Visibility*	*Positive ROI (accomplished)*	*Positive ROI (expected)*	*Operation efficiency*	*Enhance the value of the whole ecosystem*
Foodchain	Sells solutions					
Bofrost						
Pietro Coricelli						
Pralina						
Chocofair	Consultant company					
Mancini						
Latteria Sociale Val.			Public financing			
Trufflemarket						
MZBG						
Rouge						
BASF						

Impact on perceived image

Even if there were no direct measures on that all the companies interviewed has gained an incredible impact towards the brand under different terms among both business and consumers. Implementing a blockchain to trace all the supply chain was rewarded under four major aspects: company positioning, reputation, credibility, and security.

Visibility

In all the cases the media attention towards that project was extremely high. First because blockchain is a novel technology and those were among the very first applications. Secondly, because most of the companies operated in traditional end static sector, where technological innovation where mainly linked to improvement in the production processes. On the other hand, here company adopted a disruptive technology for their customers, with the aim of open the company's door to their way of working.

ROI

One of the major issues of undertaking such project, as in all the projects, is linked to return of investments. As stated, several times in this discussion, implementing a blockchain comes with costs and this could prevent firms to implement to adopt it. Before going on, it is necessary to point out that different solutions come with different cost, also according to the technological readiness of the company and the integration with EPR systems. Despite so, all the companies that early adopted those solution said that the return of the investment was positive, while the others stated that are sure is going to be repaid or it was partially repaid

Operations efficiency

This aspect was evidence mainly in companies where the solution was designed for these purposes. It come more often in long and complex supply chains, which involves different actors and an important volume of information. Indeed, having all the information available in blockchain reduce the time and the cost of managing, retrieving, and sharing that information. Even if there were just few documented real use cases, this aspect was widely discussed in the academic literature

Enhance the value of the ecosystem

Blockchain is a distributed ledger technology, and it is conceived by design to offers significant benefit to all the actors involved. This is particularly emphasized when blockchain is used as a platform: ROUGE, Risochiaro and Trufllemarket are three examples where the firm, which in this case are the platform provider, created a favourable environment where participants of each side have interest in joining the network.

Final interpretations

Theoretical point of view

The literature in the agri-food blockchain focuses mainly on the technical aspect to provide solution among complex and long supply chains, which involve a multiplicity of actors (Feng. 2016, Feng 2018, Credyt et al 2019, Galvez et. Al 2018, Jie Ju et al 2020). The main benefits coming from all these authors were: Data traceability, food Safety and quality monitoring, preventing frauds, deliver real time information to all supply chain members, and efficiencies on time and cost, and this was confirmed by empirical evidences. On the other hand, scholars suggests that the marketing, social and economic sciences' researchers should devote efforts to the application of BC and

its impact to consumer trust because this aspect is receiving very few attentions among scholars (C.F Da Silva 2021).

This work intended to address such concerns to point the main variables that can influence consumer trust towards the product, namely:

- Knowledge of blockchain technology
- Typology of product
- Familiarity of the customer on the product
- Familiarity of the customer on the production process

Customer knowledge on blockchain technology admits customers to understands the blockchain capabilities.

Managerial point of view

Data shows that customer are willing to know more about the product they consume and implementing a blockchain technology is considered by the interviewees the best and the only enabling technology that allows to have a satisfactory level of detail to satisfy customer requirements. This opportunity seems particularly attractive for SMEs which has niche products with superior quality and production processes, since blockchain can give and immutable and intangible proof of the practices that confers those attributes. Moreover, it enables companies to communicate to the customer its values, mission and commitment among consumers and society. On the other hand, it can play a differentiation level both on MNC and on direct competitors: in the first case, MNC are often not able or not willing to adopt a full transparency on the supply chain since their product quality are bundled to industrialization and high volumes. Still, adoption of this technology is still scarce and firms adopting it may benefit from first mover advantage, since benefit are not only linked to short term, but also to long term perspectives

Chapter 1 – Introduction

Blockchain was born in 2008 with bitcoin, where an anonymous user nicknamed Satoshi Nakamoto presented a to the world “a peer-to peer electronic cash system”. By the way, even if blockchain and bitcoin are always named together, they represent two separate entities. Blockchain is a distributed ledger technology that let the bitcoin system work. Ledger Technologies (DLTs) are technologies that exploit a shared register, a database that instead of residing on a single central server is decentralized and distributed over several nodes of the network, that possess a single copy of the register. Having such configuration guarantees to DLT’s different advantages compared to traditional databases: first eliminate the single point of failure, since there is no single point where information resides and there are many different copies among the network. Secondly, it enables Peer-To-Peer transaction where actors can exchange information in a trusted environment, without the need of a third-party certifying information and the validity of transactions: they are transparent and visible to all the participants, which agrees on the composition of the shared ledger. Consensus is reached through voting: at each update, each node performs a vote to ensure that the majority agrees with the conclusion reached. Even if these solutions overcome many problems related to traditional database systems, their distinctive traits are, in a certain sense, their weaknesses: without a single part that own the control in establishing which is the correct set of information, some malicious hackers could join forces to tamper the system and create a new distributed ledger containing the tampered information. Here comes the great leap forward of blockchain: a set of cryptographic rules combined with this peculiar architecture made of a chain of blocks, prevent hackers from tampering the transaction. A type of cryptographic signature called a ‘hash’ acts a kind of wax seal which guarantees that information were exchanged correctly and the fact that the chain is constituted by a sequence of sealed blocks avoid the possibility of changing them retrospectively.

As stated in the initial part of this chapter, blockchain was born in 2008 with Bitcoin, but more than ten years after that milestone, most computer scientists, scholars and

economists agree that these technologies could be disruptive in several environment, from the financial sector to the public sector. Therefore, in the last 5 years, the attention of managers and researchers moved to the application of BC technology to various industries. Among the different fields, supply chain management seems to have the perfect characteristics where blockchain application could flourish: the main challenge of the supply chain remains in the traceability and data management, which can be perfectly handles with the implementation of such system. Indeed, this technology provides an untampered and unalterable record of transaction, where product and shipping details are collected through different technologies and validated before becoming a permanent record on the ledger. Thus, this information can not only be seen from all the actors of the chain improving efficiency, but also come up to the customer hands. The importance of being able to prove origins and transparency on the product and raw material in the agri-food industry has increased dramatically, since customers have become skeptical towards firms, due to the numerous food scandals, frauds, and counterfeit products which weekly ends in their tables. Therefore, firms that establish product provenance and transparency through the supply chain may have a competitive advantage. However, turning into a blockchain system is not easy and comes with high cost. The limited number of real use cases prevent companies to understand which are the benefit and the best practices that a could enable them to leverage how to leverage this technology.

To fill this gap, this research has interviewed 15 companies and experts that have implemented blockchain for the traceability of goods, to understand which the business implication for firms and how they can generate a competitive advantage through it

Chapter 2 - Blockchain technology

2.1. What is blockchain

Blockchain belongs to the family of Distributed Ledger Technologies (DLTs), which are technologies that exploit a shared register, a database that instead of residing on a single central server is decentralized and distributed over several nodes of the network. (Nakamoto 2008) The information can represent data of any kind: currencies, contracts, certificates, the sale of goods and services or any type of asset that can be transformed into digital form.

To be clear in the terminology adopted, blockchain is only one part of a larger family called Distributed LedgerTechnologies (DLT) is a larger family of technology, one of the which is blockchain. This new architecture has revolutionized the aforementioned family since establish a new logic of decentralization and distribution of data and information where there is no longer a single copy of a register, but it is shared among all participantsof the network.

Moreover, the registry no longer p resides on a single physical server but is located on a large number of machines at the same time. The data is entered, shared, and synchronized by a distributed network of nodes. No one has the possibility to "override" other participants and modify the registry without their permission because the validation process goes through a rigidconsensus procedure. (Z. Zheng, et. Al. 2017)

What distinguish Blockchain technology among the DLT is the uses cryptographic techniques to share data within a"chain of blocks", from which it takes its name.

Like the accounting ledger, it is a collection of transactions that are carried out among users of a network. It involves a chain of interlinked blocks, each

of which collects a set of transactions. Here an example: a transaction between Alice and Andrea is hypothesized, which could represent for example the exchange of money. The transaction is transmitted to the blockchain network that will validate it through a set of rules defined as consensus algorithm, that is going to be presented in the subsequent discussion. Once validated, this exchange of information will be included with other transactions within a "block" and added to the "chain".

The whole process ensures that each block is created and irrefutably linked to the previous one.This guarantees the immutability of the chain and makes it impossible to modify it.

As in a ledger, transactions are constantly shared and synchronized between all nodes in thenetwork.

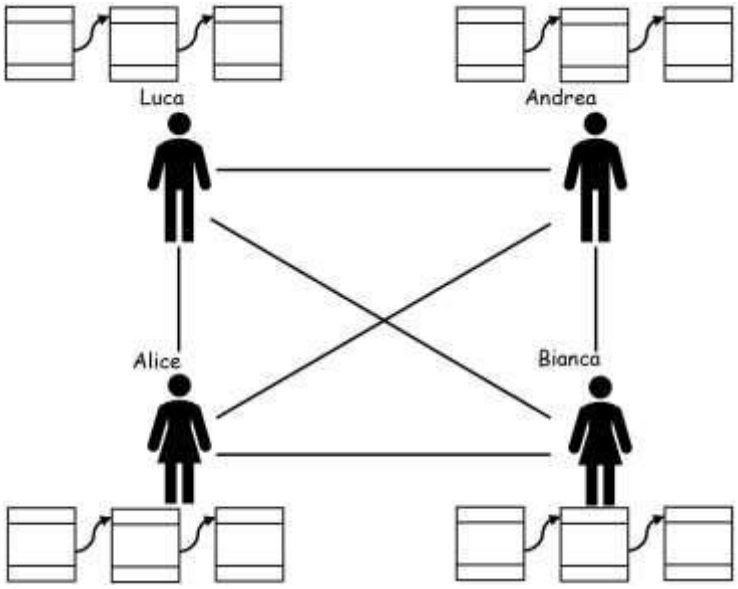

Figure 1: Distributed technologies

As noted in the figure, each participant has a copy of the blockchain that will be synchronized each time a block is added.

2.2. Features

Blockchain is stored invariably on the machines of all the participants, which from now will be called nodes, in such way that all those partners have the same information and in retrospect, no manipulations are possible (Ianisiti 2017, Lasi et. al 2018) The main advantage of this protocol is the difficulty in altering the structure and the data within it.

In fact, a system of this type can guarantee everyone the possibility to verify and have total transparency on actions and transactions because they are recorded in immutable and shared archives that have the characteristic of being immune from corruption.

The technology is basedon four fundamental features (Zheng, et. al 2017)

- Decentralization
- Tamper-resistance
- Transparency
- Security

2.2.1. Decentralization

Unlike current databases, in Distributed Ledger Technologies there is not a single point which stores all the information: the register is decentralized, and there are several copies distributed among the different nodes of the network, all equal one each other. There is no central entity that controls the system, each participant collaborates for the proper functioning of the network, validating and adding transactions to the blockchain.

Consequently, there is no need of any intermediaries or third parties an actor has to refer to when a transaction takes place, as it now happens in centralized systems (e.g. banks). Trust in a system like this is based on a set of rules that defines the consensus mechanism, the process that define how information are verified and added to the chain.

The aspect for which blockchain has gained great popularity lies in its ability to ideally lead to a world without intermediaries. In the Bitcoin white paper published in 2009 by an unknown figure called Satoshi Nakamoto, a year following one of the biggest financial crisis that led to the loss of people's trust in financial institutions, an email with this pseudonym was presenting to the world a disrupting technology that has the potential to revolutionize a large bunch of industry (Tapscott & Tapscott): "I developed a completely decentralized system, without central servers or intermediaries because everything is based on cryptographic evidence instead of trust" (Nakamoto, 2008).

The fact that there is no central entity allows the system to be extremely resilient and secure. There is no single point of failure, so the network is more difficult to attack than comparing to traditional structures. To do so, it would be necessary to have the computational power to take control of the majority of nodes (51% attack).

This would only be possible if the majority of nodes, those whose goal is to add new blocks to the blockchain, agreed and took control of the system. The possibility that this will happen is very remote and will become increasingly difficult as networks grow, since the computational power and the cost associated to it makes the tampering extremely disadvantageous. There are some evidences of past attacks like the one in 2016 to Ethereum, one of the most developed and used blockchain, testify that in digital reality nothing can be considered as an invincible protocol. On the other hand, most protocols have not been tampered yet. Despite considering that cracking a system as Bitcoin which current Market Cap value is around 1 trillion could be economical beneficial, the cost and the real possibility of setting a system with enough computational power can be comfortably considered zero

2.2.2. Tamper resistance

A second important feature of the blockchain is the tamper-resistance. In fact, it is extremely difficult to change or delete the transaction record entered in the network. In order to make a change, as seen above, you must receive an approval from the other nodes in the network. Any change made to the record is visible to the whole network, so it is impossible to enter one without it being noticed. The only way to be able to modify the register is through the re-proposal and re-authorization by all the nodes. The way it is designed, and the various validation and encryption processes guarantee the immutability of the register and ensure that there is only one version that records all transactions since the creation of the blockchain. It is important to note that tamper-resistant does not mean immutable or unchangeable, despite its decentralized nature this technology is not immune to attacks but still ensures great security.

2.2.3. Security

The question that arises is: how is it possible that this new technology is safe if there is no central authority that defines rules and sanctions? The answer relies exactly in the concept of decentralization of the ledger. If previously there was only one ledger managed and updated by the authority, now each participant in the network has a copy of the database containing al the information. Thus, each of them can view, examine and if respecting a system of rules, can modify it. It is kept track of every single transaction and when a new information is entered, the nodes update at the same time. This guarantees a constant and anonymous control of the truthfulness of the data according to the different types of consensus rules that will be analyzed later. Security is given by the fact that, once a block is added to the blockchain, tampering it by including or excluding certain transactions requires a great investment of time and money, as it was said previously. By using a time marker called Timestamp, each transaction is associated with a string of characters that publicly certifies the date and time when it took place. This allows the different parties to verify by whom and when a particular transaction was made and it allows that an operation, once executed, will not be altered or cancelled. Moreover, as is now practice in the digital field, encryption is used, a technique that makes a message incomprehensible to those who are not authorized to read it. In the case of blockchain is used not to hide information but to make the system secure and to not allow tampering.

2.2.4. Transparency

Another fundamental property of this technology is transparency. Indeed, in the initial concept of blockchain conceived by Nakamoto, all transactions are visible and verifiable by all participants. The development of the technology has then led to some changes, where only some nodes can see or validate the transactions, but in any case, the cardinal principles of the technology do not change. The public register contain a chronological list of all transactions in an orderly and sequential manner, so the complete history of all transactions can be seen in any condition. This property allows to increase the trust and security of users joining the network but at the same time could also create privacy issues. For example, full data transparency creates problems when there is some personal information which an actor does not want to be publicly available. This is currently one of major point of debate and discussion and there is no common point among the community in finding a satisfying trade-off between transparency and privacy, especially in public and open blockchain networks. A proposed solution is to save sensitive and confidential data "off-chain" or in other databases, like cryptocurrency owners do with cold ledgers. For them it is first a matter of security, since the probability of having their asset stolen from the web decreases from almost zero to exactly zero. On the other hand, this should solve another problem of blockchain solutions, namely the enormous storage space needed by a blockchain to operate. In this way, it will not be necessary to store all the data in the chain, the ones not necessary to the functioning of the blockchain will be saved outside of it, limiting the space needed and improving performances. Security will be guaranteed through cryptography and data will be linked through a hash reference, a system that will be analyzed later, so private information can be seen only if you have permissions.

2.3. Types of blockchain

As previously described, blockchain technology is part of a broader family called "Distributed ledger technologies", a new logic of decentralization and distribution of data and information where there is no longer a single database and governance is built around a new concept of trust between all parties. There are various types of Distributed ledger technologies with different architectures and functionalities. There are two main variables that discriminate between types of blockchain: validation rights and assets rights (Garzik, 2015). When anyone can access and read information we are talking about public platforms. Instead, if the access to information is restricted to users authorized by a central authority, the platform will be considered private or closed. A second categorization depends on who has the ability to send and validate transactions. If anyone can do it, the platform is defined permissionless, otherwise, if you need to be authorized to make a transaction, the platform is considered permissioned.

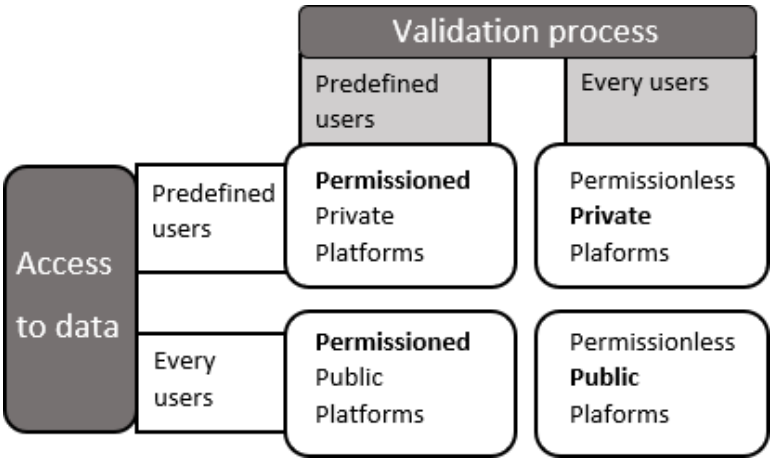

Figure 2: Types of Blockchains

In general, as described in the figure, there are four large types:

- Public permissionless platforms
- Public permissioned platforms
- Private permissioned platforms
- Private permissionless platforms

In the following figures white dots will be used to represent the validator nodes, those participants able to validate transactions and participate in the consensus mechanism. On the other hand, black nodes are the users able to make transactions but that are not authorized to participate in the consensus mechanism to validate information. Finally, a circle will be used to point out who can access the transaction log, nodes inside can do it, nodes outside cannot do it.

Public permissionless blockchains

In this type of blockchain, anyone can actively participate in the functioning and maintenance of the network. The only requirement is an internet connection, all the users participate in the validation through the consensus protocol and, instead of the existence of thirdparties to ensure the accuracy and truthfulness of the information, there are various mechanisms defined consensus algorithms that provide transparency and security.

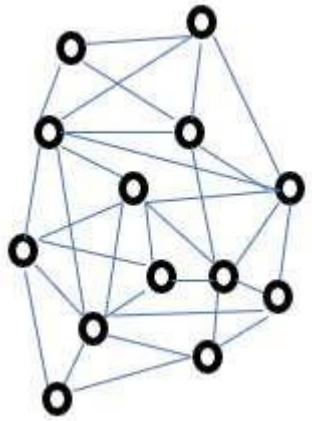

Figure 3: Public permissionless blockchain

Examples of these platforms are Bitcoin, Litecoin, Ethereum.

Public permissioned blockchain

The difference from the previous ones lies in the fact that only a small number of nodes can participate in the consensus mechanism. These nodes are called "validator nodes". The information remains visible to everyone, anyone can make transactions, but only these last nodes are able to validate them.

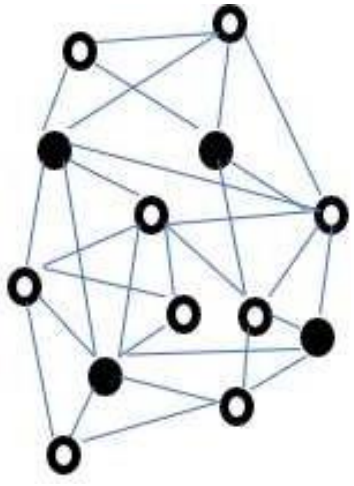

Figure 4: Public permissioned blockchain

Companies around the world are more and more opting for this type of platform, since it allows them to have much of the benefits of blockchain technology while maintaining control over the activities carried out by all participants. They can enter restrictions and configure the network as they want, tailoring the structure to their needs

Examples of these platforms: Ripple

Private permissioned platforms

This type of platform restricts the ability to make transactions and to view the transaction record to authorized persons only. The network owner has full control, it decides who can participate in the system and who can participate in the consensus mechanism. The central authority supervises the correct functioning of the network, and it knows the identities of the main participants. The security is maximum, knowing the validator nodes, only trusted nodes are able to validate the information.

Examples of these platforms are: Hyperledger and Rubix

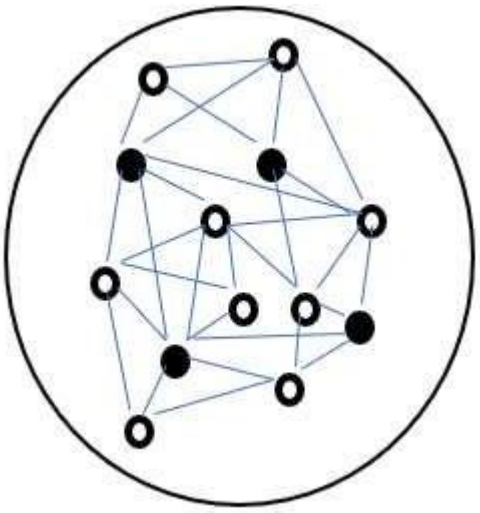

Figure 5: Private permissioned platform

Private permissionless platform

It is not a very common type. These are platforms where the visualization and the possibility to make transactions is restricted to authorized users even if the consensus mechanism is open to all. These platforms allow companies to collaborate without the need to share information publicly. The functionality of the public part resides only in the verification of data and events.

Examples of platforms like these are: LTO networks and Holochain.

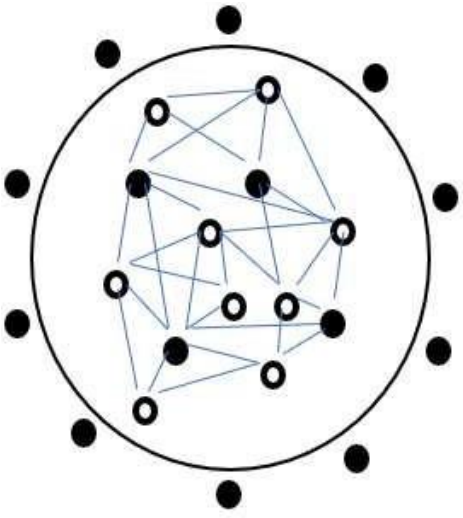

Figure 5: Private permissionless platform

Consortium Blockchain

There is also an additional type of blockchain that combines elements of private and public platforms. These are the blockchain consortiums, instead of a public system where anyone can validate the information or a private one where a central authority makes decisions,a consortium provides that the governance of the platform is entrusted to a set of organizations. They are also called semi-private platforms because they guarantee the control of private platforms but also benefit from the characteristics of public ones.

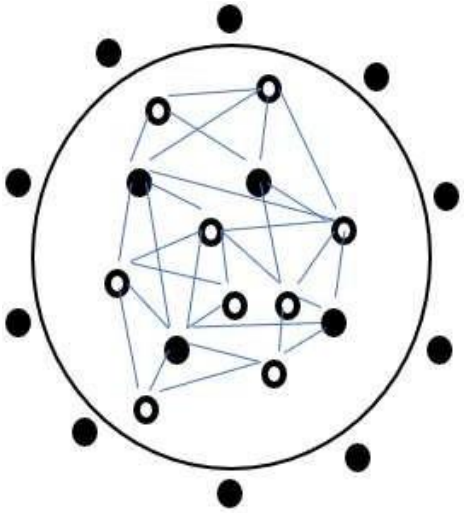

Figure 6: Consortium blockchain

Platforms of this type are often used between companies working in the same sector and need a common environment for transactions and data storage.

Examples of platforms like these are: Almaviva

The table below summarizes the different nature of blockchains

Property	*Public blockchain*	*Consortium blockchain*	*Private blockchain*
Consensus determination	All miners	Selected set of nodes	One organisation
Read permission	Public	Could be public or restricted	Could be public or restricted
Immutability	Nearly impossible to tamper	Could be tampered	Could be tampered
Efficiency	Low	High	High
Centralised	No	Partial	Yes
Consensus process	Permissionless	Permissioned	Permissioned

Table 1:comparison between blockchain protocols

It is impossible to establish which type is the best. By contrast the contest where a blockchain could be implemented player a key role in define which is the best type, since each of them has some advantagesand disadvantages.

Let's see what the advantages of private platforms are compared to public platforms:

- The nature of private platforms provides more security, it enables participants to have more confidence in other members as only trusted third parties are invited to join the network.
- the reliability of all members allows for a less robust consensus mechanism than publicones. This allows to have different consensus protocols, which can guarantee a faster validation speed.
- The company that manages the network can simply change the rules and modify the information saved on the shared registry.
- Errors and inaccuracies can be corrected through manual operations.

- They guarantee more privacy, the information is not public and visible to anyone. Following the latest measures and regulations in this field many companies have decided to opt for these platforms.

On the other hand, public platforms also provide advantages. As described in his paper in 2009, Satoshi Nakamoto's goal behind the invention of Bitcoin was to create a peer-to-peer network without central authorities. The features of a public platform protect users from the network provider, no single individual or organization can prevail over others by gaining control of the information. As explained above security and trust are guaranteed by consensus mechanisms, a user must not place trust in a central body but in the blockchain itself and in the mechanisms of cryptography and consensus.

2.4. Technological foundation

Each blockchain platform has its own characteristics and peculiarity. Since analyzing the difference in the technology and computational performances goes out of the scope of this work, for sake of simplicity in the next chapters all the references are going to refer to the Bitcoin network. It was chosen to use it since Bitcoin’s blockchain is it is considered the blockchain par excellence

2.4.1. Cryptography

Before the treatise spoke about great security of blockchain technology, but what no proof were reported on how this technology can provide this kind of security. It has been underlined that the data, i.e. transactions, are not hidden but public and shared, but what ensures that they are not tampered? The answer to this question is: cryptography.

Cryptography is a technique of making a message incomprehensible to those who are not authorized to read it (Shannon 1949). It is not a new technology,

since it has been used also during World War II. The novelty resides in the way in is used in the blockchain: the use not so much to hide data, as it was initially conceived and used for, but to make the system secure and make it impossible to tamper. There are two cryptographic schemes used in the blockchain: hash functions and digital signatures.

A hash function is an algorithm that takes a string of arbitrary length and returns a string of fixed length. In the case of Bitcoin the SHA-256 hash function is used, which return a string of 256 digits. This algorithm embeds three main properties

- Consistency: the same hash must be associated with the same messages.
- Non-invertibility: the function must not be invertible; it must be impossible to go back to the original message starting from the hash.
- Uniqueness: the probability that two different messages are associated to the same hash must be almost zero.

Changing even one character of the original message would revolutionize the whole hash, and it is impossible that two differ contents gives the same hash. As mentioned above the blocks of a blockchain are linked by hash, where each block contains the hash of the previous block and a change within it would change its hash and would invalidate all subsequent ones since they would no longer match. As a source of additional security, in blockchain technologies are used asymmetric key algorithms or public key algorithm. It relies on a pair of Digital keys, which are the instruments allowing the use of cryptographic security model to prove the ownership and to enable that transactions occur correctly between two parties. Each actor of the chain (node) possesses a pair of keys which are generated and stored by users through a software. The software creates and

contains a collection of interrelated key pairs: one is called “public-key” and it can be shared and used by all node of the network. On the other hand, “private key” is owned by the actor and cannot be shared with other parties. These elements can be compared to one of a bank transfer: public key can be associated to a bank account number (IBAN), which can be used by any kind of person and it is public knowledge which person is associated to that Iban. By contrast the private key work similarly to a secret code or a signature authorizing the access to that specific account number. Indeed, the public key is used to generate an address which represents the node identification address in the blockchain. So, if an actor what to have a transaction with a specific actor, he should find it is public address.

This is a cryptography system based on the mathematical function which is considered irreversible: it can be effortless calculated in one way, but there were no successes in calculating it in the opposite way, thus (up to now) it can be considered impossible. A system randomly generates a number, corresponding to the private key (k); the private key is used to engender a public key (K) through the aforementioned mathematical process. The use of these keys in blockchain is to encrypt the outgoing message and be able to decrypt and understand the received message. Everything that is encrypted with one of the two keys can be decrypted with the other key of the pair. So, anything that is encrypted with the Public Key can only be decrypted by Private key of the same agent. As mentioned before, an important property of key pairs is that it must not be possible in any way to trace one of the two keys back to the other, and this guaranteed by the Elliptic Curve Cryptography

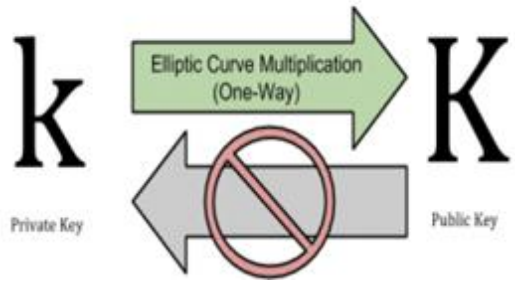

Figure 7: Double key properties

So, the public key can be distributed while the private key must remain secret, and the agent must keep it properly. Since it is impossible, for the property mentioned above, that you can trace the related key knowing only one, the security of the second is not undermined. Asymmetric encryption is used for two purposes: to guarantee confidentiality and authenticity.

In the first case the sender encrypts the message with the recipient's public key, so that only the recipient, thanks to his private key, can decipher and read it. In the second case, the one that affects the Blockchain field, the message is encrypted by the sender with the private key in his possession and the recipient can verify its authenticity by decrypting it with the sender's public key.

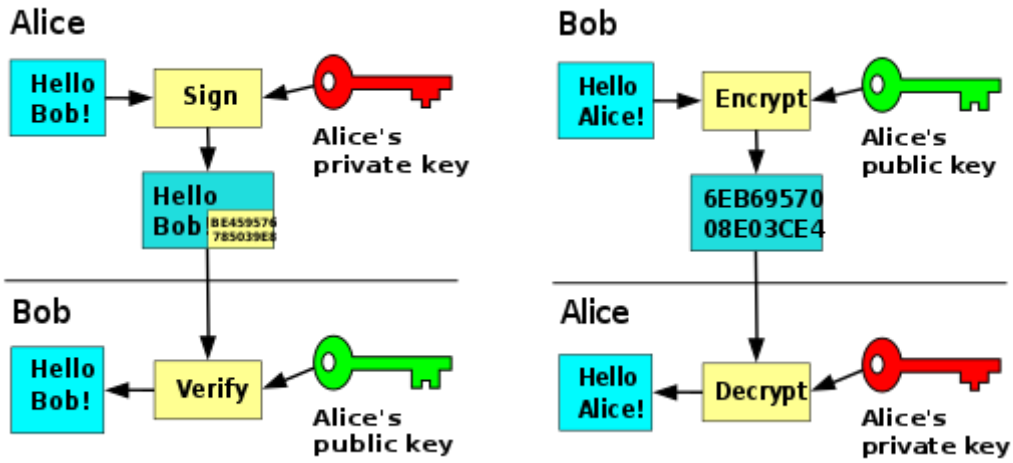

Figure 8: Public (left) vs Private (right) key encryption

2.4.2. Distributed consensus

Distributed consensus is one of the most important and revolutionary aspects of blockchain technology. It is the mechanism that the register is continuously and securely updated in the correct way. It allows the validation of new information to be entered and aims to protect the network from attacks and malicious people. Achieving consensus in a network of nodes means to ensure that nodes converge on a common value and "give permission" to enter that value within the blockchain.

Being the process "distributed", the task of control and validation no longer belongs to a centralized institution, but it is in the hands of a large number of nodes which has to agree on the common version of the ledger. In order to reach a consensus on a distributed ledger the problem of Byzantine Generals Problem has to be solved. (Lampert et. al). It describes the difficulty of decentralized parties have in arriving at consensus without relying on a trusted central party and can be reformulated as Nakamoto did in 2008.

The Byzantine Fault

The byzantine problem was first theorized by Lamport and many different versions of it currently exists. Here it is going to be presented the one that Nakamoto brilliantly solved answering to a mail of J. Donald arguing among the stability of the system. There are three or more Byzantine generals who must decide the time to attack the enemy. The attack can be successfully launched only if all generals agree on a common decision, while a halfhearted attack by a few generals would become a rout. They don't particularly care when the attack will be, just that they all agree. It has been decided that anyone who feels like it will announce a time, and whatever time is heard first will be the official attack time. Nonetheless there is the possibility that one or more of the generals could be traitors with the intention of confusing the otherers and communicate a wrong attack time, or they may retreat. Moreover, the network is not instantaneous, and if two generals announce different attack times at close to the same time, some

may hear one first and others hear the other first.” The problem is to find an agreement, communicating only by messages, and not in a simultaneous way.”

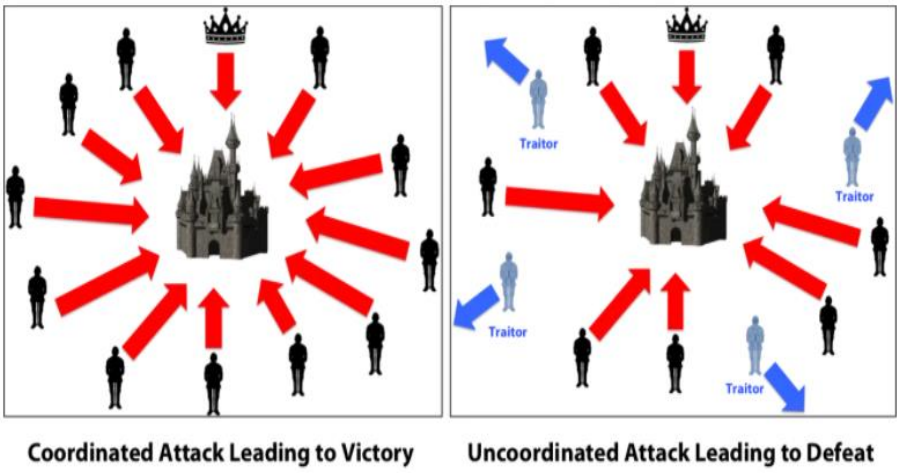

Figure 9: Byzantines general problem

2.4.3. Consensus algorithms

Proof of Work

The POW is Nakamoto’s idea (Nakamoto 2008) to solve the Byzantine General problem and it was conceived it the world’s first blockchain (Bitcoin). He theorized to solve the problem as follow: every message exchanged by generals must be associated with the solution of a problem that requires and high computational power to be solved. Despite so, this solution is extremely easy to be verified by the participants of the network. So, in order to send a message, a general must first solve a difficult problem and then attach the solution that can be verified by the other generals. In this way it is very expensive for a node (the generals) to send numerous malicious messages through the network.

In practical terms, a node to mine a block has to generate a hash of the block of transaction and present the solution to the network. Generating just any hash for a set of bitcoin transactions would be trivial for a modern computer, so in order

to turn the process into "work," the bitcoin network sets a certain level of "difficulty." This setting is adjusted so that a new block is "mined" (which means added to the blockchain by generating a valid hash) approximately every 10 minutes. Setting difficulty is accomplished by establishing a "target" for the hash: the lower the target, the smaller the set of valid hashes, and the harder it is to generate one. In practice, this means a hash that starts with a very long string of zeros.

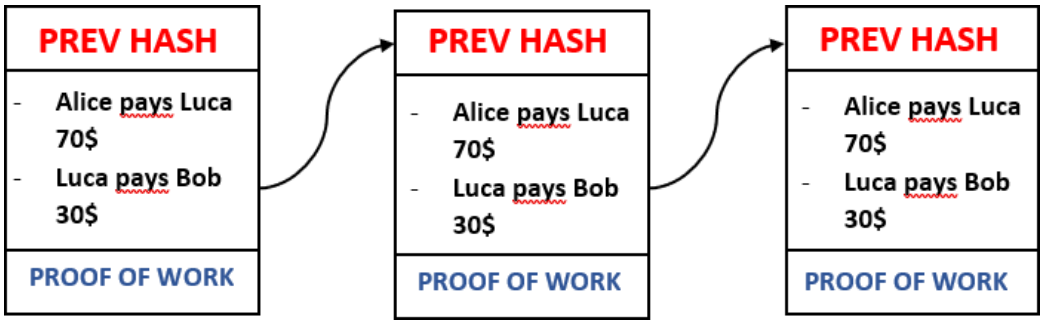

Figure 10: Proof of work

Even this solution brilliantly solves the problem, it embeds several drawbacks related to the architecture of the solution: The computational power required to close (mine) a block is very high and this at arises concerns the energy consumption and consequently, the cost of the of the entire network. (Kayas et al 2017). Indeed, early calculations indicated that the energy requirements of the protocol were comparable to that of a small country (O'Dwyer et. Al 2017)

Proof of stake

Problems related to energy consumption has motivated the investigation of alternative blockchain protocols that would obviate the need for proof of work by substituting it with another, more energy efficient, mechanism that can provide similar guarantees (Kayas 2018). First implemented in 2012 in the form of the cryptocurrency PeerCoin (S. King et al), Proof of Stake (PoS) is of a hybrid design,

where PoW is used for initial coin minting and PoS is then used for most of the network security. Within a PoS system, each coin's age is taken into consideration in the form of "coin-days." This concept is simply explained through example: holding 10 coins for 10 days equates to 100 coin-days. Upon spending these coins in a transaction, the age of the coins is consumed and reset to zero. Unlike in a PoW system, where the chain with the most work is seen as the main chain, a PoS system uses the chain with the highest consumed coin age.

$$proofhash < coins \times age \times target$$

This way, instead of utilizing energy to answer PoW puzzles, a PoS miner is limited to mining a percentage of transactions that is reflective of their ownership stake. For instance, a miner who owns 3% of the coins available can theoretically mine only 3% of the blocks and it gives a great advantage in the power consumption (L.M. Bach et. al 2018)

The result is the same, validate transactions and add blocks to the blockchain but in this case validators are forced to block a certain amount of money that, if the intention is malicious, they will lose. An attack to a network would be extremely expensive since the attacker would need to obtain 51% of the cryptocurrency to carry out a 51% attack. The proof of stake avoids this ‘tragedy’ by making it disadvantageous for a miner with a 51% stake in a cryptocurrency to attack the network. Although it would be difficult and expensive to accumulate 51% of a reputable digital coin, a miner with a 51% stake in the coin would not have it in their best interest to attack a network that they hold a majority share.

Protocol nature	
Proof of Work	*Proof of Stake*
Mining capacity depends on computational power	Validating capacity depends on the stake
Miners receive block rewards + transaction fees	Validators do not receive block rewards, only the transaction fees
For an attack, hackers need at least 51% of the computational power of the network	For an attack, hackers need to own at least 51% of the total amount of currency

Table 2: PoW vs PoS

Fork

In the decentralized network, valid blocks might be generated simultaneously as a result, forks may be generated as shown in the figure below. However, it is extremely improbable that those two competing forks will generate next block simultaneously for architectural reasons: taking as a reference a POW protocol (but it can be considered the same if we adopt a Pos or whatever consensus mechanism), a chain that becomes longer is considered by the protocol as the authentic one. Let's consider the two forks created by simultaneously validated blocks B11 and G11 in the figure. Miners work on both the forks and add the newly generated block to one of them. When a new block (say B12) is added to block B11, the miners working on fork G11-G12 will switch to B12. Block G12 in the fork G11-G12 becomes an orphan block since it is no longer increased. Generally, after a certain number of new blocks are appended to the blockchain, it is nearly impossible to reverse the blockchain to tamper the transactions. In Bitcoin blockchain, when approximately six blocks are generated, the relevant blockchain is the authentic one (e.). Block interval depends on different parameter setting. Bitcoin block is generated about every 10 min while Ethereum block is

generated about every 17 s. This is a clear sign on how different architecture have different performances

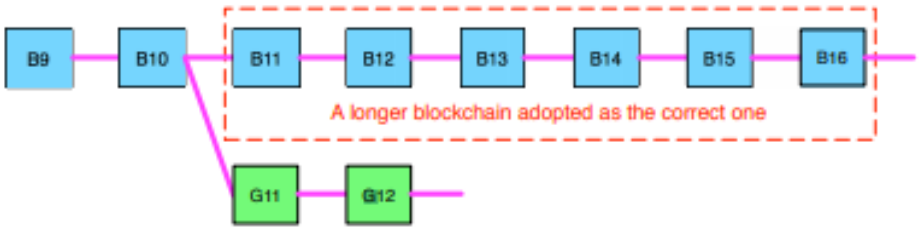

Figure 11: Fork

2.4.4. Timestamping

This a are solutions that use the distributed ledgers to certify the exact date of a certain event or document. It consists of applying a digital signature, composedof an alphanumeric code that will then be shared on the blockchain. The attachment ofthis timestamp allows to establish the existence of a certain document and verify that ithas not been modified over time. The digital signature is composed of two components, the document hash and the timestamp. The hash guarantees immutability, in fact if thedocument will be modified or altered even by a single character, its hash would change.The timestamp gives the exact time when this document was signed. The sum of the two components therefore allows to demonstrate that the document existed exactly inthat form at a given time.

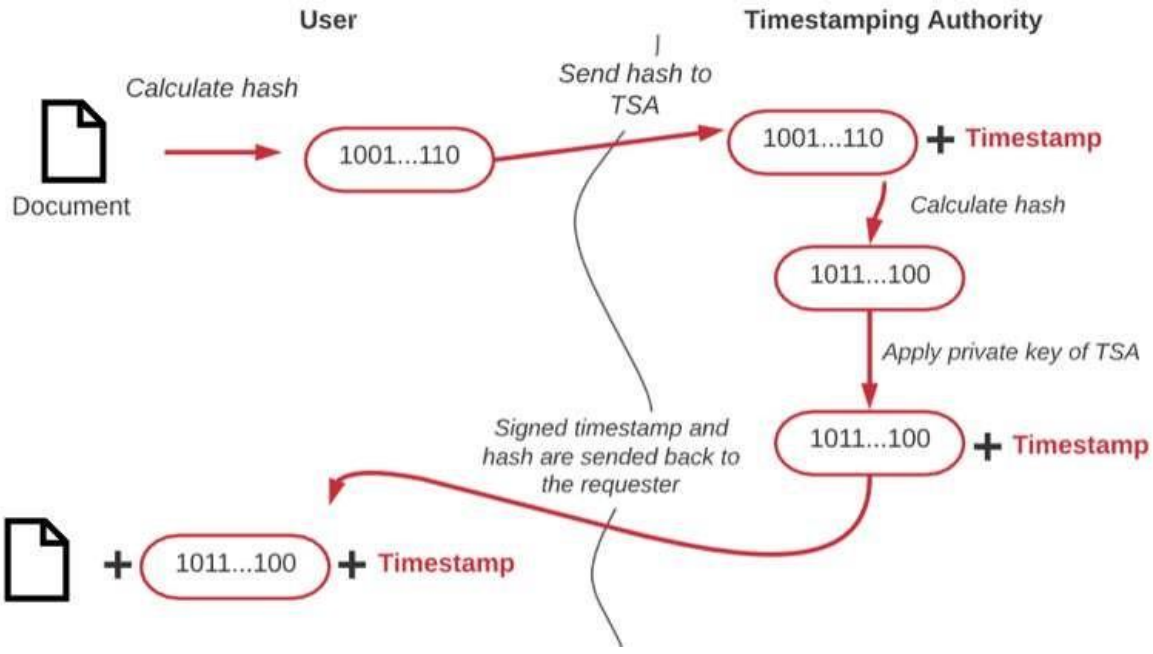

Figure 12: timestamping

Chapter 3 - Literature Review

3.1. Blockchain current state of the literature

Once technical fundamentals of blockchain have been analyzed, it is important to understand the maturity of point the academic researchers are on this topic and try to grasp what has not yet been covered. As a starting point, an interested an interested article of paper of J. Frizzo (Frizzo 2020) in which Frizzo and colleagues performed a systematic review of scholarly research on blockchain technology in the business literature, pointing out several interesting points.

Firstly, the authors of the cited paper have analyzed which areas and topics are most studied.

The greatest number of papers in the population focused on blockchain in relation to banking and finance (31%). they also identified papers that focused chiefly on other areas of business (25%), law and governance (22%), ethical and social concerns (10%), accounting and record-keeping (9%), technological overviews (8%), privacy (7%), smart contracts (7%), supply chain (6%), arts and culture (4%), healthcare (4%), and education (3%).

In can be clearly seen that supply chain is a underdeveloped areas of study, even if the authors regards around the salience of this technology in this sector. Indeed, they underline of the importance blockchain's impact on the supply chain, which is also confirmed by many scholars (Casino et. al 2019, Saberi et. al 2019, Crosby 2016, Tian F. 2016 , Kshetri, N. 2018, Huges 2019)

Moreover, after cryptocurrency, supply chain is one of the most popular use cases for blockchain, as evidenced by various chains developed for this

purpose including HyperLedger, VeChain, Modum, and Waltonchain. For instance, and Walmart has tested two supply chain initiatives powered by Hyperledger Fabric, a block chain built by IBM, to track Chinese pork and Mexican mangoes from producer to consumer (Hackett, 2017; De Castro 2018; M. Creydt et. al. 2018)

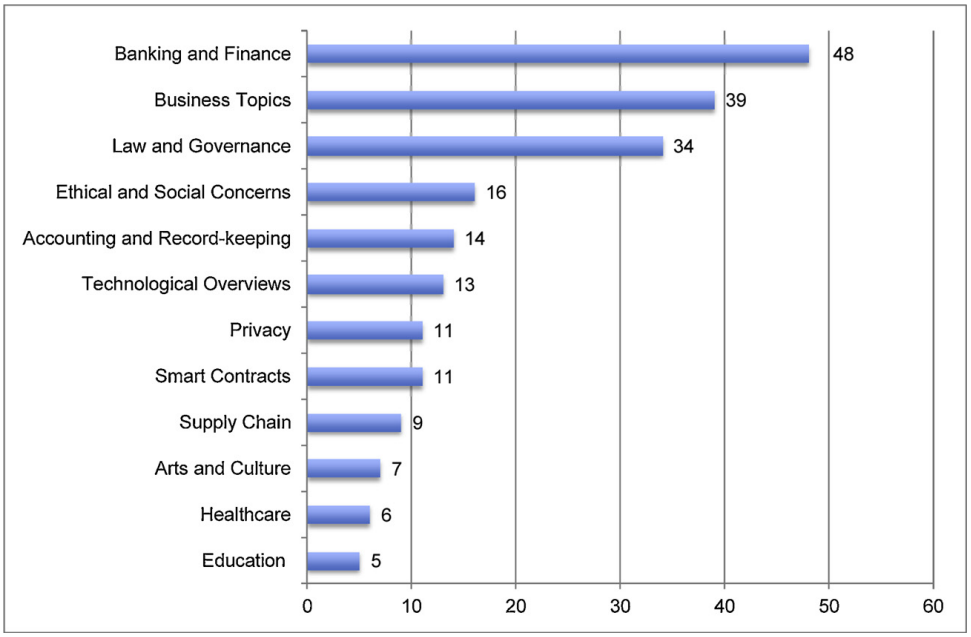

Figure 13: studies focused on blockchain in relation to topics

Then the article continues trying to point out which are the main benefits of blockchain technology which are very often framed in technological, structural, or financial terms. This analysis can be still useful to understand how the technology can impact and improve business and society at large.

The top benefit associated with blockchain for business and other social applications, cited by 50% of studies, is its trust-free, transparent nature which eliminates the need for intermediaries. In addition, its decentralized structure is a source of benefits for 46% of the papers. Its protocol and the way it is designed provide integrity and security by ensuring strong network reliability and resilience. The point of failure is no longer just one as in

traditional structures, to make non-operational a blockchain network it would be necessary to attack a large number of nodes. Studies cite as benefits the potential increase in efficiency (24%) and the decrease in transaction costs (19%). To conclude Studies also referenced the interconnected concepts of security (20%), privacy (12%) and data ownership (8%)

Last thing that is interesting in this paper to address is the kind of research performed over time.

The figure below shows the ratio of conceptual vs. empirical papers over the period. The figure shows that the ratio of conceptual papers and empirical papers changes very little over time. It' s reasonable to see the blockchain space, or any new space of innovation, as rapidly evolving, in the academy as much as in industry. However, the figure clearly shows the academic pace of change from exploratory research to empirical investigation remains in the very early stages. Some of the papers taken under analysis rely on personal observation, hypothesizing, or preliminary reflection on how blockchain applications will affect certain industries, which contributes to the fragmentation of blockchain research at the present

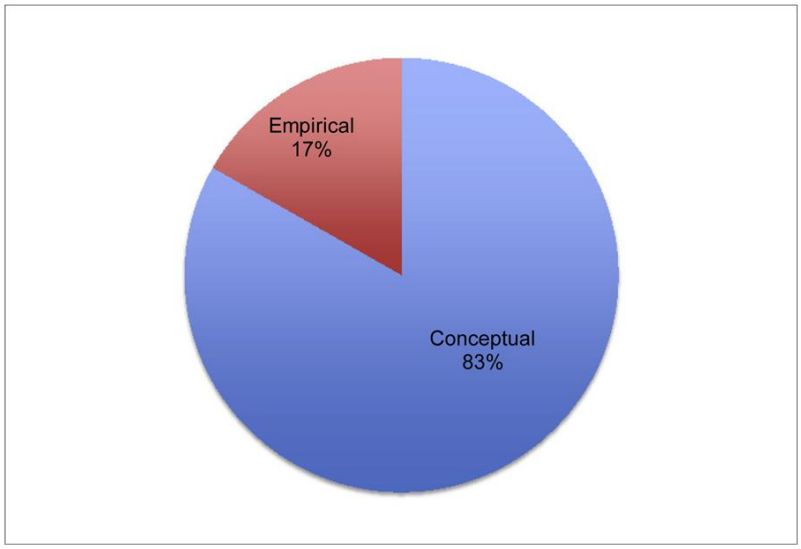

Figure 14: Conceptual vs empirical studies

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In addition to this high-level breakdown, the paper categorizes the types of papers the authors found according to their various research methods (Figure 16). Findings shows the presence of the majority of exploratory studies (63%), followed by theoretical frameworks (14%), case studies (12%), scoping and systematic reviews (5%), statistics (3%), interviews (1%), comparative studies (1%), and survey (1%).

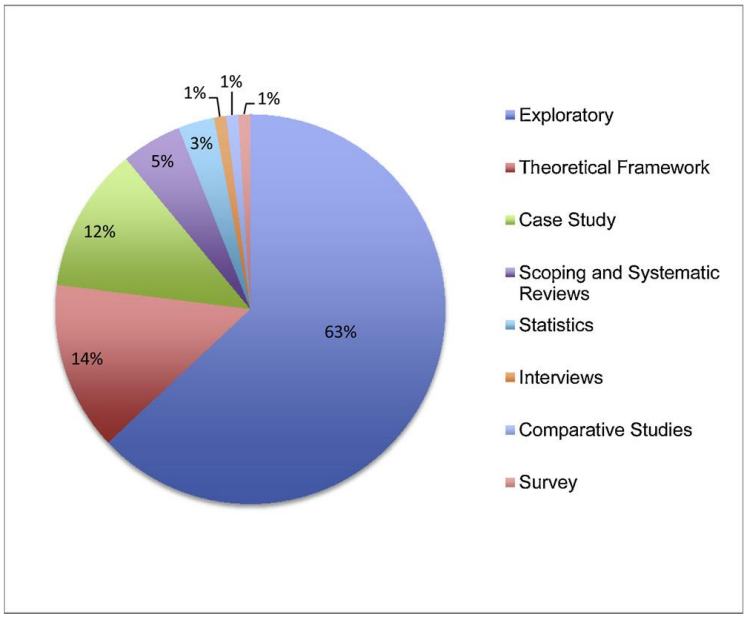

Figure 15: Research methods

3.2. Commercial applications of blockchain and Business implications

In the literature there is evidence that underline the scarcity of commercial grade blockchain applications currently exist, even if the technology demonstrates significant potential to benefit several industry wide use cases. That is why organizations are demonstrating increasing interest in blockchain technology due to the promise of significant business benefits. Although blockchain technology and cryptocurrencies in general have received considerable attention within the last few years, studies have highlighted those transformative applications are still not commercially available and few organizations have progressed their blockchain solutions beyond the feasibility or prototype stage (Axios,2018; Iansiti & Lakhani, 2017). Given these challenges, it is not surprising that few organizations are prepared to commit significant investment beyond the prototype stage to bridge the gap between promised and actual business value. Studies have generally tended to focus on the technical and performance aspects of blockchain concentrating on themes such as security, performance, and privacy in the context of cryptocurrencies and their potential disruption to existing processes (Dorri et al., 2017; Li &Wang, 2017). There is a poor knowledge on the business field, indeed there is a percentage of above 80 percent of studies which have focused on the technological aspects of blockchain, while less than 20 percent discussing blockchain applications and the business focused challenges (C.F. Da silva et. al., 2021, Yli-Huumo et al., 2016,), which is the main issues for firms. However, a more business debate seems to be emerging within the literature, where studies tend to look beyond the technical features of blockchain while on realistic applications, limitations of the technology and overall business benefits to the organization as Kuo et al., 2017 did in the medical industry, while Ølnes et al., 2017 focused on government issues.

A wider perspective concerning different business application was undertaken by Grover and colleagues exploring a number of use cases within Business to Government, Business to Business and Business to Consumer contexts, highlighting the wide potential for the technology and its application. The Table 3 highlights the various blockchain use-cases for businesses in relation to consumers, businesses, and governments. The study points out how using blockchain infrastructure, businesses can provide trusted user interfaces for consumers along with facilities of instant payments and better traceability of goods.

Consumers	Businesses	Governments
• Trusted user interfaces • Instant payment facilities • New incentive receiving system • Traceability of goods	• Storing of the records, Snapshot sharing • Autonomous execution • Accounting • Market disintermediation • Business process management • Provenance tracking	• Digital storage, authentication and maintenance • Smart trust codification • New market of digital payment services • Global commerce

Table 3: blockchain use-cases for businesses in relation to consumers, businesses, and governments.

The pragmatic emphasis on the commercial benefits to the organization is continued in Drescher (2017), where the study sets out the criticality of an "added value" perspective when comparing traditional centralized systems to blockchain based peer to peer architectures. Under his point of view, the integrity within a blockchain network is expensive when compared to centralized systems and this current of thought find agreement also with other scholars (Bach et. al. 2018, Saberi et. al 2019). Therefore, organizations need to address the commercial realities when assessing the perceived benefits vs centralized based solutions (Drescher, 2017). Moreover, organizations should be aware of the potential business risks associated with blockchain solutions while still able to leverage the opportunities and benefits of its adoption. The commercial realities of blockchain were reviewed also by Michelman

(Michelman et. al. 2017), where the study was aiming to compare the cost and the benefit of a blockchain solution compared to a traditional centralized systems s in two main aspects first reduction in costs associated with transaction audit and verification and second) the costs of exchanging value between parties due to not relying on a costly intermediary. The study associated these commercial benefits with the inherent characteristics of blockchain and its ability to securely record and timestamp all transactions within each block.

Although numerous studies have extoled the virtues and transformational nature of blockchain technology, the large-scale deployment and adoption of blockchain solutions is not imminent and many prospective commercial applications are still at the prototype or feasibility stage. Thus, Blockchain applications Are more likely to be developed by firms within specific sectors such as finance, logistics and supply chain, where the potential benefit can be realized. However, A clear benefit clear picture of the benefits is not available in any industry, even if maybe the finance industry is the more developed under this point of view.

3.3. Barriers of adoption

Successful implementation of blockchain technology to traceability practices and managing supply chain processes and products through the supply chain begins with the identification of challenges and barriers to be managed. (Mendling et al. 2017). For this reason, it is fundamental to understand which are the major barriers that prevents companies to adopt blockchain technology. In this specific work, the focus wants to be in the implementation of a blockchain system for the traceability of products. Her an adapted framework from Saberi et. al. 2019 is presented with the intention to summarize all the relevant barriers in four according to 4 main categories: intra-organizational barriers, inter-organizational barriers system-related barriers and external barriers

3.3.1. Intra organizational barriers

These are the set of barriers that are created within the organization coming from company's internal activities. One of the major issues is Top management support, since it plays a key role to the successful implementation of any practice, especially supply chain ones. However, some managers fail to have long-term commitment and support to adopt a new technology. This lack of management commitment impedes integrity of practices through supply chain processes and would challenge resource allocations and financial decisions (Fawcett et al. 2006). This problem become even greater if the issue is about adopting a blockchain technology for the traceability of products often comes with high costs (Garaus et. al 2021, Regattieri et. al 2017, Mougayar 2016, Jie Xu et. al. 2020). These costs are mainly linked on the investment in new hardware and software for information collection.

Another important issue, the lack of the required new organizational policies. Implementation could be a challenge, since adopting any new edge technology as blockchain in supply chain processes requires new roles, responsibilities, and expertise to support different aspects of the technology (Mendling et al. 2017). This reflects on the limited technical expertise and knowledge of using blockchain technology Moreover, converting to new systems may change organizational culture or hierarchy and lead to resistance and hesitation from individuals and organizations (Jharkharia and Shankar 2005). If organizations wish to have transparent supply chains with supporting a new information technology that is adopted by all the supply chain network, they need to embed sustainability practices into their organizational vision and mission (Mathiyazhagan et al. 2013).

Lastly, since Blockchain technology is in its early stages, there are limited number of supply chains that successfully implemented this technology to track their products

and the lack of business models and best practices in implementing blockchain technology is a challenge (Mougayar 2016). On the contrary a driver that can improve rate e adoption in implementing transparency is customers' demands for sustainable products and processes. But in the other perspective, the lack of customers' awareness and willingness to contribute to sustainable development is a barrier for the implementation of such technology in the supply chain (Tang 2016)

3.3.2. Inter-Organizational barriers

In this kind of barriers there are external actors, who we can more generally identify as partners that could provide an obstacle to the implementation of BC for a traceability system. Indeed, relationships between partners could be challenging, especially when it comes to integrating information technology. On the one hand, Blockchain technology would facilitate information sharing through a supply chain, on the other hand, although information transparency and verifiability is a need for evaluating sustainability performance of a supply chain (Sarkisand Zhu 2018), some organizations may assume information as a competitive advantage which makes them unwill to share valuable and critical information (Fawcett et al. 2009; Sayogo et al. 2015). The hesitation to reveal information from some partners may limit the full benefits of adopting blockchain technology and hinder successful implementation of this technology.

Moreover the lack of solid rules for information sharing could impact on the level of collaboration among supply chain partners (Gorane et. al. 2015). This kind of interaction could prevent an effective communication among supply chain partner, thus impacting negatively on the implementation of blockchain technology to create business value. Finally, information collection for blockchain technology purposes mostly needs its own facilities and devices. RFID is solutions to such an issue, which comes with associated costs.

3.3.3. System- Related barriers

Even if depends on the typology of technological solution that a company adopts (Bach et. Al. 2018) to implement blockchain technology and gather information for supply chain management purposes new IT tools are needed. This can be a challenge for some supply chain participants (Abeyratne et. al. 2016). All the participants of a chain need to access the required information and the fact that not all of them could be able to implement a technological system which guarantee to access real-time information in a supply chain is affect is feasibility.

Moreover, blockchain technology could suffer from a dimension problem: as it was presented in the first part on this work, many blockchain technology, especially if we consider ones which embrace proof-of work, are immature technology in terms of scalability and are not able to handle a large number of transactions in a time effective way (Yli-Huumo et al. 2016). Another major problem, especially in the consumer market, is that blockchain technology is associated primarily with cryptocurrencies such as Bitcoin and with its malicious activities (Swan 2015), the 'dark web' reputation, which slows down blockchain technology adoption in general and prevent consumers to understand and trust the technology. Lastly, another problem coming out from different authors (Swan 2015) is that not the full processes are automated with IoT, and their humans are still involved in applying this technology with the possibility of having erroneous recorded data with a garbage-in garbage-out effect.

3.3.4. External barriers

This category introduces challenges coming from external stakeholders, industries, institutions, and governments. A limit to the adoption of blockchain technology is the lack of appropriate governmental and industry policy that push companies to approach the digital transformation and to sustain safe practices with advanced technological mechanism (Mangla et al. 2018). Governmental regulations and laws are still unclear about the usage of blockchain technology. (Frizzo et al 2020). Hence, governments, NGOs, industries, communities, and professional organizations should promote blockchain technology to create sustainability value.

In addition, According to Saberi et al 2019 demand uncertainty for sustainable products and customers' behavior ambiguity may affect market competition and impede the integration of blockchain technology. (This because Organizations need to ensure that their investment on green products, sustainable processes, and a new technology like blockchain would be compensated by their customers. On the other hand, many other scholars argues that this there is an increasing demand of customer about traceability of products and fair practices which companies needs to address (IBM Consult European Food Responsibility Study, Feng Tian 2017, Juan F. Galvez 2018, Montecchi 2019, Kang and Hustvedt, 2014)

3.4. Blockchain system for traceability of goods

Blockchain has the power to enhance the data transparency, realize data traceability, improve the safety and quality monitoring of product, and reduce the cost of financial transactions, (Tian 2016, Credyt et. al. 2018), since it is secure, immutable, decentralized, transparent and tamper resistant (Nakamoto 2008). These characteristics are promising to enable consumer trust (Beck et al., 2016; Hawlitschek et al., 2018) and provide many benefits at the business level, even if they are still obscure since the early level of adoption of the technology. Studies underlines the importance to be transparent for companies: for example, studies show how consumers' perception of a corporation's efforts to be transparent plays a critical role in building consumers' trust and positive attitude toward the corporation. This in turn develop their intentions to purchase from the corporation and spread positive WOM about the corporation and its products. (Kang et. al 2014). Another study Singh (Singh et. al 2012) underlines how that Consumer perceived ethically (which can be achieved by implementing transparency on processes) has a significant and positive relation with both product brand trust and product brand affect, which in turn affects brand loyalty

This recalls the importance on how the combination of two digital assets, namely Blockchain and QRcodes and a physical one (RFID) could play a fundamental role in proving transparency in the consumer's eyes. The customer can directly check the information by scanning the QR code directly on the product and verify all the quality standards on which a product goes among the supply chain. Relevance of this topic increases especially for egg, meat, and dairy products since there are studies assessing that with 66-74% of people paying attention how the animal was raised in Spain (Freund et. al. 2018) while more than 88% of respondents on a European survey stated that they care about their food provenance (IBM EUROPEAN FOOD RESPONSIBILITY STUDY). Moreover, consumer more and more concerning among social and ethical issues, and they tend to ask for companies guarantees of fair practices (CGF FUDTERRA, Jie Xu 2020)

In this section it is going to be presented an exemplification of how it is possible to implement supply chain traceability thanks to blockchain, RFID and QR codes. The example is taken from Bumblauskas et. al 2020 which applied a blockchain for eggs traceability in the US. Currently in Italy there are many there are many solutions available with different protocols and different networks. By the purpose of this study, there is no need in understanding the technical and operational differences among different solutions, why it is useful to understand how the mechanism works.

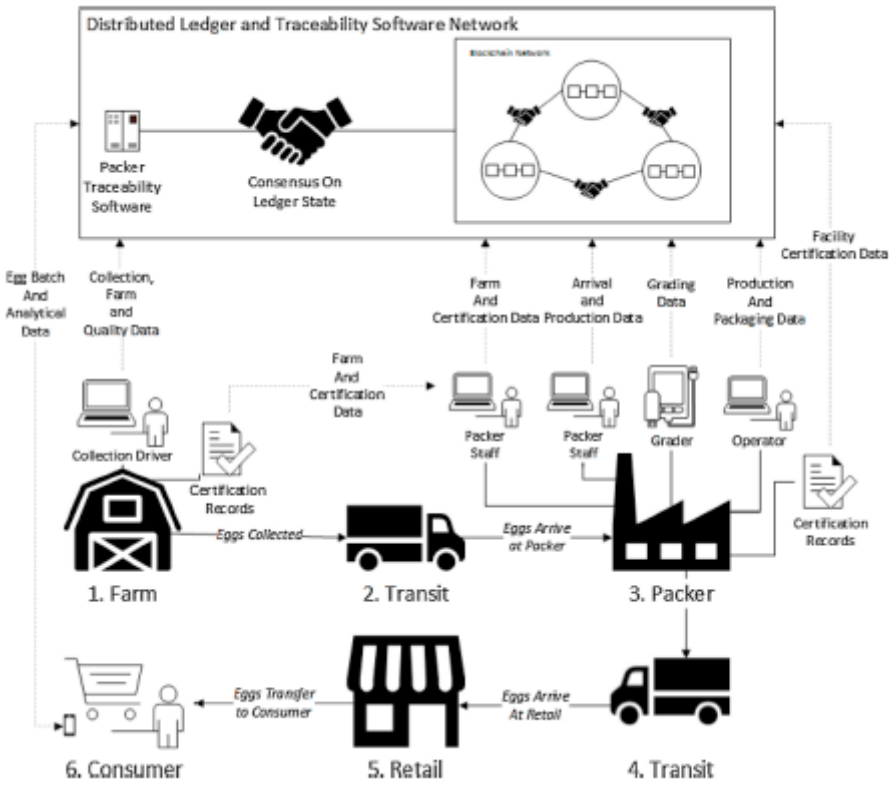

Figure 16: Data flow in the system

Blockchain solution adopted in this specifical example was private network, meaning transactions submitted to the network and nodes participating in consensus are limited and regulated by an on-chain network policy as it was shown in the previous sections. This type on protocol can be advantageous in this specific case, Participants are known and there is a better efficiency compared to

public protocol (Bach 2018).

In this example data are collected among 3 main locations:

1. The Farm: Data was captured where the eggs are collected when the collector logged the egg type and pickup time. Temperature, location, and humidity data were captured by sensors on the farm.

2. Packaging Facility: For data capture within the packaging facility. The data captured at these two points created a record of transactions on the blockchain including collection location and time, farm name, temperature and humidity history, transit departures and arrivals, processing and packaging time, egg type, certification data, batch quantity, best-by date, brand, color, product labels, and any possible supplier overlaps during processing and packaging times.

3. The Consumer Scan: QR codes were placed on select free-range egg cartons between. The web application containing traceability data was accessible to consumers via a scannable QR code on product packages and requested input of data printed on the end of the carton to access traceability data for a particular carton. Website analytics within the web application collected data about the number of users accessing the site, their behavior, time spent on the site, visits per user, and other general data about their interactions on the web application. Below there are exemplification of the web application.

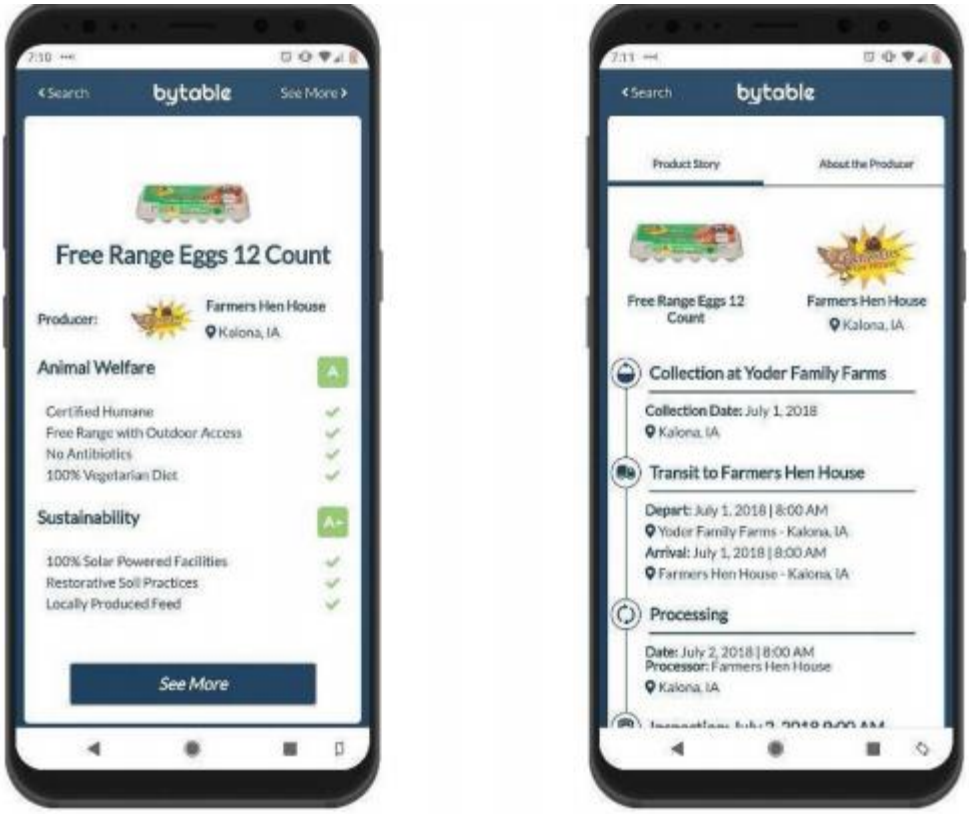

Figure 17:Web application

In the forementioned framework the value of the product could be extremely improved by strictly guaranteeing the quality and safety in the systems using the forementioned technologies. RFID technology can automatically identify multiple objects simultaneously, without manual intervention and has been widely used in production-processing among supply chains (Tian 2016). In these supply chain processes, RFID systems provide management information and safety data of agri-food for producer, wholesaler, retailer, and consumer. Thanks to this technology, a supply chain management could realize the tracing and monitoring of "from farm to fork", and once the food safety issues happen, we can find their source and solve the problem immediately. Besides that, it also uses blockchain technology for guaranteeing the information which shared and published in this traceability system that is reliable and authentic

3.4.1. Advantages of a blockchain traceability system

Assessing the advantage of blockchain traceability system is not easy, due to several reasons: first it is an emerging technology, thus the full potential has not been developed yet and most of the potential has not been unveiled. Second, there are only few commercial applications available and in the literature the majority of the paper addresses technical perspectives. Third the model which are present in the current literature are for the last majority conceptual frameworks how the technology could be applied in those field and the theoretical advantages that this could bring to all the actor of the supply chain. Despite so, an analysis was done taking into consideration articles with 80 or more citation in for "blockchain" AND "traceability" in the Scopus database, focusing on the agri-food sector. Various researchers proposed different blockchain-based traceability system that involved different technologies such as RFID, IoT, NFC, cloud computing, and big data, as well took different agri-food value chain entities into consideration. Regardless the mere technical advantages in terms of computation power, memory and other computational related features, which are not in the interest of this work, here are presented the major benefits provided each of the paper presented

Feng T 2016: (1) Benefit to tracking and traceability management; (2) Benefit to enhance the credibility of the agri-food safety information; (3) Benefit to fighting against fake products

Feng T 2018: (1) Can deliver real-time information to all supply chain members; (2) Improve the efficiency and transparency of the food supply chain; (3) Extremely reduce the risk of centralized information systems.

BisWas et al. 2018: The proposed traceability system enables transparency, accountability, safety, and security in the overall process from the grape to the bottle.

Boehm et al 2018: Do not need to share a private key to sign a transaction, assuring the confidentially of personal information.

Caro et al 2018: Creating transparent, fault tolerance, immutable and auditable records for the traceability system.

Davcev et al. 2018: 1) Transparent and secure supply chain system can be achieved; (2) Real-time information on the air temperature, air humidity and leaf wetness and soil moisture 3) lower power consumption

Lucena et al 2018: 1) All the members in the Agri food supply chain can share the same business rules and transaction data, transaction transparency were improved.

Frow this perspective a blockchain system in the supply chain of Agri food products can benefit from the intrinsic of characteristics of blockchain technology. It can provide a Secure, immutable, and transparent information systems, where actors in the chain can access to transparent and real time information. This ensure the safety of products, since enhance the traditional level of monitoring and improve efficiency, because there are many steps of audit in of the traditional supply chain that are automatized. Of course, there is also an impact at a system level: the fact that player in the chain has to submit to the same rules and must be fully transparent with other participants enhance the credibility of the system in terms of trust and reliability.

3.5. Impact on provenance on consumer behavior

Provenance is defined as "information about the creation, chain of custody, modifications or influences pertaining to an artifact" (Cheney et. al. 2009. As customers have become increasingly skeptical among established firms (CGF 2019), firms that are able to proof product provenance may have a competitive advantage. Provenance knowledge comes from supply chain transparency in terms of how products pass along the whole supply chain process from manufacturing up to the point they are delivered to the customer. Provenance knowledge can increase customers' trust by assuring the origin, authenticity, custody, and integrity of products as this assurance in turn can reduce perceived risks that can impact purchasing decisions (Antony et al, 2006; Featherman et. al., 2003) which includes for example financial, psychological, social, performance and physical risks (Bauer, 1967; Jacoby et. Al. 1972). Customers can perceive risk when there is information that is hidden from them in a product's supply chain. This perceived risk can influence customers' purchase decisions and attitude (Antony et al., 2006) Risks between company and consumer are perceived since the two parties have different information and this information asymmetry can lead to undesirable consequences for the customer (Akelof 1970). Undesirable consequences reduce the utility function of and individual: since individuals are rational agents, they will try to maximize his utility and therefore to reduce the risk as much as they can.

These perceived risks can be grouped into five dimensions according to Bauer (Bauer, 1967): financial, psychological, social, performance, and physical risk. Here is a short explanation on the dimension of the risks:

- Financial risks are created when it is uncertain as to the extent of the opportunity, time, or monetary costs of using and owning a product (Kim et al., 2008)

- Psychological risks are perceived when a product purchase decision could threaten customers' self-Image of self-concepts (Featherman et. Al. 2003)

- Social risk is originate from negative evaluations of others (Featherman et. Al. 2003)

- performance risks are originated when the functionality of products are uncertain due to malfunction or unexpected performance (Grewal et al., 1994; Jacoby et. Al 1972)

- Physical risks are perceived when products could result in harm to customers or other people (Berman et. al. 2010; Jacoby et. al., 1972; Mitchell, 1999).

Firms can anticipate the development of these perceived risks and apply transparency interventions that offer additional information to resolve any information asymmetry perceived by customers. As risk perceptions direct customer behaviour, these inventions can mitigate the risk and impact positively on the perception of the firm (Jacoby et. al. 1972) Traditionally, firms have used third-party rating services (e.g., ISO, DOP, trademarks) to reassure customers of their processes, but there are some practitioners that believes certifications are helpful but not good enough to their scope. (CGF-Futerra-Transparency-and-the-Honest-Product 2019). Thus, Customers tend to seek product reviews from other customers to add information and reassurance.

Blockchain technology offers firms another solution to reduce these risks by transparently recording all transactions related to a product, thus increasing provenance knowledge. From the perspective of customers, interventions aimed at improving their knowledge of a product's provenance can impact evaluations of that product by providing four types of assurances: origin, authenticity, custody, and integrity (Figure 19). Blockchain technologies delivers these assurances by providing traceability, certifiability, trackability, and verifiability of product information along the supply chain. Through these assurances, impact the different dimensions of customers' perceived risk: financial, psychological, social, performance, and physical risk.

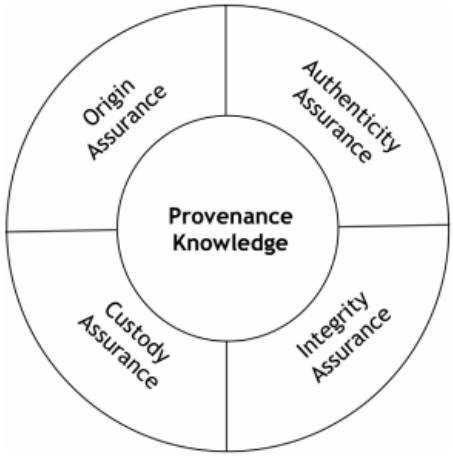

Figure 18: Assurance wheel of provenance knowledge

These concepts were framed by Montecchi and colleagues (Montecchi et al 2019), with the intention present a comprehensive picture that was able to put in place relationships among the three dimensions analysed before: Blockchain capabilities, Provenance knowledge and customer perceived risks.

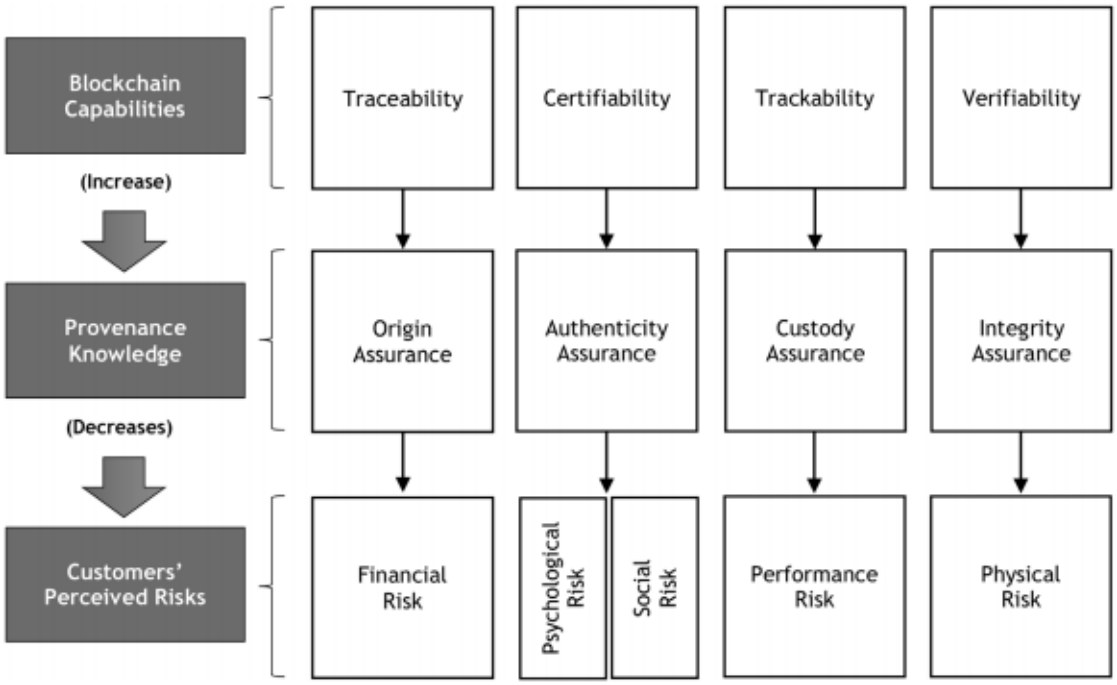

Figure 19:Blockchain enabled Provenance knowledge

3.5.1 Traceability-Origin Assurance-Financial risk

Origin assurance (namely, the country of provenance) involves several aspects linked to the place where brands and products come from. The place where a product is produced can impact customers' product evaluations, customer opinion and purchasing intent (Hall et. al. 2015; Laufer et. al., 2018). The same thing can be said for the parts that make up the product, such as the ingredients of a food product. These effects are based on stereotypical views of countries associated with products and

brands' origin (e.g. Chocolate that is manufactured in poor countries). Such beliefs streamline customers' information processing and provide mental shortcuts in evaluating products' features and performances (Cheah et al., 2016). These stereotypes of the place where products come from are subsequently used to evaluate the quality of product and if customers hold favourable associations towards the country and its image, origin assurance can rein force their perception of product quality and reduce perceived risks associated with the purchase and consumption. This is what typically happens when a product is distinguished by "made in Italy". By enhancing product traceability, blockchain allows customers to discover the origin of a product and of its components or ingredients (in case we refer to a food product) in a way that is secure certified and cannot be altered by any party. An example on how this can reduce the financial risk is provided in the fashion industry: consider a fashion brand fashion with expensive materials. Customers might rely on previous experiences and acquired expertise to form a general opinion about the quality of the product. In doing so, customers might miss out on important details about the quality of the materials, including their origin and sourcing. Therefore, customers would benefit from the traceability function of blockchain to secure origin assurance and reduce the perceived financial risk of paying a premium price for a product made with these materials.

3.5.2. Certifiability- Authenticity assurance – Psychological/Social Risk

Authenticity assurance is critical in many purchasing contexts because customers tend to confer greater attention to product that communicate authenticity (Beverland et al, CGF). In considering different products, customers might find difficult challenging to discern between true or fake authenticity. Therefore, firms use various types of policies and trademarks to certify products' authenticity. However, conventional certifications (e.g., trademarks or DOP) are costly and require strict audits by a third-party authority (Abeyratne et. al. 2016). On the other hand, increased provenance knowledge can provide authenticity assurance by establishing stronger associations with the products or brand's place of origin (Iversen et. al, 2008). For this purpose, Blockchain technology offers valuable solution to certify the authenticity of products in a more

secure and transparent way. It provides an alternative to classics authenticity seals because supply chain partners must verify and agree on every transaction related to the product, which at this point become secure and immutable. This can in turn reduce psychological and social risk in the mind of the customer. For example, thinking about the market for counterfeit luxury products, it easy to understand that luxury brand suffers from counterfeiters which offers product apparently equal at a lower price. Moreover, for some customers, imitation priced below the recommended selling price could be an attractive option. On the other hand, there are customers who buy counterfeit products at full market price even thinking the product was an authentic one. This left them inevitably dissatisfied with quality and performances, put the brand in an uncomfortable position (since it is not the real cause of the problem) and generate psychological and social risks associated with the purchase for the customer. Through blockchain, a link between a physical product and a trusted digital identity can be established, recording in the blockchain database the information to guarantee product authenticity. Customers are able to access the information included in the digital asset and confirm the authenticity of the product.

3.5.3. Trackability-Custody Assurance-Performance risk

Custody assurance is associated with the trackability of products through the different stages of the supply chain to ensure higher levels of control and confidence. Customers' confidence in the purchase is reinforced by having information on the chain of custody and its management, including transportation and storage conditions and methods. This is what could happen in a cold chain management: if the product is not maintained at the right temperature, there can be several problems connected to the performance of the product, which in turn can affect, for example safety of the products. For this reason, customers' expectations of transparency are increasing, putting pressure on firm to implement systems which provide visibility of each stage, to reassure them they are in a safe condition (Huges 2019, Saberi 2019).

Blockchain's trackability contributes to custody assurance because all decisions and modification are tracked for each stage of the product lifecycle and who access to the product can recognise the lifecycle of the product (eg. stocking, modification, or delivery). Here is an example of how trackability can reduce the Performance risk: An old fine wine must be stored at a very specific parameters of temperature and humidity conditions to maintain its worth. So, when the customer buys it, he wants to be sure that the along time all this relevant figures has been respected. By establishing a certified line of custody with blockchain by tracking the wine through its long life from the vineyard to the customer's personal wine collection, customers can assess quality prepurchase. This type of provenance knowledge reassures customers and reduces the functional risk that wine is off because of faulty transportation and inappropriate storage.

3.5.4. Verifiability- integrity assurance- physical risk

A product can be considered intact when its integrity level is in line with meets customers' expected levels of quality and reliability, delivering superior value, and ultimately representing a critical source of competitive advantage for the firm (Clark et. al. 1990). Customers assess the integrity of products by using intrinsic and extrinsic cues (Olson et. al. 1972). Intrinsic cues are linked to the actual tangible characteristics and associated to the performances of the product, while extrinsic one is influenced by external stimuli, including marketing efforts, and knowledge of product provenance. Moreover, perceived integrity of a product can reinforce customer purchasing intent (Abeyratne et. al. 2016). Integrity is associated with physical risk of having a product damaged or not conformed with its characteristics Blockchain technology can support the verification of information concerning products by providing visibility of all supply chain transactions, which traditionally have been hidden or difficult for customers to access. This process can assure the integrity of products by providing transparent access to transaction information across the supply chain.

Chapter 4 - Research Gap

Literature about blockchain focuses mainly on technological aspects and how specific sectors are influenced by the technology. The papers that analyse how blockchain can influence and improve business processes are many. Feng tian 2016 analyse for example the agri-food sector and how technology could improve product traceability along the supply chain, Liang, Zhao et al. 2018, do the same for the healthcare sector, and Brilliantinova 2018 in his research discusses the emergence of blockchain technology in the energy sector. Despite so, empirical studies are very few, there is no research based on practical experience and real projects. There are no studies that analyse the technology as a whole and how it affects business value. Companies struggle to perceive and understand how the blockchain can create value for their business model. BC can incorporate trust by design and this paradigm shift from external third-party rules' verification to built-in trust among participants of a BC network. Moreover, the lack of empirical evidence is a barrier of adoption since companies are worried to implement blockchain in their traceability systems due to the doubts on how to benefit from it. Implementing a BC for traceability of product comes with high cost and companies wants to see a clear pictures before implementing it.

For this reason, a gap emerges in the literature:

RQ: Which are the reasons for which company should implement a blockchain in traceability system?

To fill the gap coming from the lack in the empirical studies, a series on company was interviewed to understand the practical implications. Moreover, the study has a focus on the food industry, seems according to many scholars (Montecchi et. al 2018, M. Credyt et. al 2018, Bamblauskas et. al 2017, Hugues et. al. 2019) and practitioners (IBM FOOD RESPONSABIITY STUDY, CGF FOODTERRA) there is an urgent request from customer and business among traceability of food.

Chapter 5 - Methodology

To answer the research questions listed in the previous chapter an inductive qualitative research based on multiple case studies has been used. This chapter deeply describe the methodology used by the researcher to structure the empirical analysis, the interview protocol, and the evidence collection.

5.1. Research design

Research design is fundamentally concerned with how authors report on how their research has been conducted (Ashworth et al., 2019). An inductive qualitative research method based on multiple cases studies has been used. Two main notions need to be defined: inductive qualitative research and multiple case sampling. As regard for the first one, Eisenhardt 1989 defines building theory from cases as “a research strategy that involves using one or more cases to create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence.” According to Edmondson and Mc Manus (2007), theory-building research using cases typically answers research questions that address "how" and "why" in unexplored research areas particularly well. As regard for the second main concept, according to Miles et al. (1994), qualitative means that empirical research drew primarily from data in the form of words, that is, language in the form of extended text. Finally, induction means that new knowledge is created thanks to generalization based on the observation of specific instances (Eisenhardt, 1989).

Therefore, this type of methodology has been chosen for several reasons, for instance:

4. It is highly descriptive, it emphasizes the social construction of reality, and focuses on revealing how extant theory operates in particular real examples (Eisenhardt, 2007).
5. It especially appropriates in new topic areas and the resultant theory is often novel, testable, and empirically valid.

6. Most of blockchain project have been constituted in the last 4 years, so there is a little knowledge on how to use this technology, how to take advantage of it. Moreover, the important of building theoretical construct for interviews leaves space to further researchers to test analytically the outcomes of the research.

The table below define the main steps of this type or research that will be better described in the following paragraphs.

Step	Activity	Reason
Getting Started	Definition of research question	Focuses efforts
	Possibly a priori constructs	Provides better grounding of construct measures
	Neither theory nor hypotheses	Retains theoretical flexibility
Selecting Cases	Specified population	Constrains extraneous variation and sharpens external validity
	Theoretical, not random, sampling	Focuses efforts on theoretically useful cases—i.e., those that replicate or extend theory by filling conceptual categories
Crafting Instruments and Protocols	Multiple data collection methods	Strengthens grounding of theory by triangulation of evidence
	Qualitative and quantitative data combined	Synergistic view of evidence
	Multiple investigators	Fosters divergent perspectives and strengthens grounding
Entering the Field	Overlap data collection and analysis, including field notes	Speeds analyses and reveals helpful adjustments to data collection
	Flexible and opportunistic data collection methods	Allows investigators to take advantage of emergent themes and unique case features
Analyzing Data	Within-case analysis	Gains familiarity with data and preliminary theory generation
	Cross-case pattern search using divergent techniques	Forces investigators to look beyond initial impressions and see evidence thru multiple lenses
Shaping Hypotheses	Iterative tabulation of evidence for each construct	Sharpens construct definition, validity, and measurability
	Replication, not sampling, logic across cases	Confirms, extends, and sharpens theory
	Search evidence for "why" behind relationships	Builds internal validity
Enfolding Literature	Comparison with conflicting literature	Builds internal validity, raises theoretical level, and sharpens construct definitions
	Comparison with similar literature	Sharpens generalizability, improves construct definition, and raises theoretical level
Reaching Closure	Theoretical saturation when possible	Ends process when marginal improvement becomes small

Table 4: Process of Building Theory from Case Study Research (from Eisenhardt 1989)

To sum up, qualitative research methodology allows to provide a good understanding of the dynamics underlying the relationship and using multiple case studies increases the likelihood of generating novel theory in the early stages of research on a topic (or to provide freshness in perspective to an already researched topic) for which existing theory seem inadequate (Eisenhardt, 1989)

5.2. Case study selection

The choice of selecting multiple case studies is rooted and driven by the academic research. According to Eisenhardt 2007, the theory is better grounded, more accurate, and more generalizable when it is based on multiple case experiments. The multiplicity of cases enhance the creation of a more robust theory, since the propositions are more deeply grounded in varied empirical evidence. Multiple cases also enable broader exploration of research questions and theoretical elaboration.

Yin 1994 provides an exemplifying metaphor about case studies and laboratory experiments saying that: "like a series of related laboratory experiments, multiple cases are discrete experiments that serve as replications, contrasts, and extension to the emergent theory. But while laboratory experiments isolate the phenomena from their context, case studies emphasize the rich, real-world context in which the phenomena occur."

Thus, theory building from multiple cases typically yields more robust and testable theory than single-case research.

Case studies typically combine data collection methods such as archives, interviews, questionnaires, and observations (Eisenhardt, 1989). Given the qualitative approach of the research the main data sources were the following, according to the research phase:

- Academic articles: to gather knowledge about the research topic (Blockchain and its applications) to find literature gaps and to define research questions.
- Company and organization reports, policy papers and institutional websites: to collect information about the selected case studies, in particular as regard for the insight and studies some of the firms made on the selected topic.
- Interviews to top executives which were in charge of the blockchain project of the firms. For sake of completeness, it has been chosen to select companies situated in different point of the value chain, in order to grasp all the insights coming from different sources with different perspectives and with the purpose of finding a common ground.

Since the interviews were the main source of data for generating insights about the research topic, the following paragraphs will better explain how they were conducted and how they were further processed and analyzed.

5.3. Respondents and interview structures

Qualitative data are useful for understanding the rationale or theory underlying certain relationships or may suggest directly theory which can then be further strengthened by other research or quantitative support (Jick, 1979). Qualitative data, at their best, are words that emerge from observations (field notes), interviews (transcripts), or documents (researcher memos and institutional documents) (Eisenhardt, 1989).

For the scope of this research, direct interviews to representatives of firms, were preferred. Interviews often become the primary data source because they are a highly efficient way to gather rich, empirical data, especially when the phenomenon of interest is highly episodic and infrequent. In fact, according to Eisenhardt (2007), numerous and highly knowledgeable informants view the focal phenomena from diverse perspectives.

The following chart shows the process followed to find the contacts of potential interviewees.

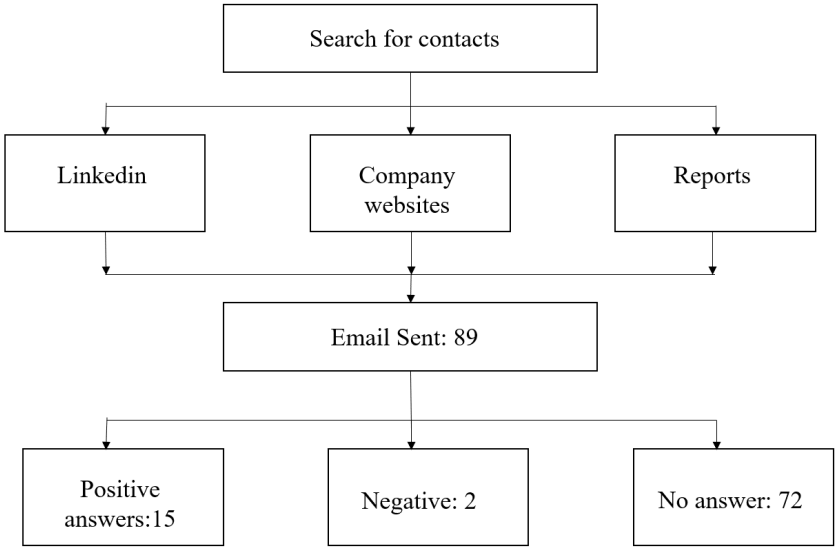

Figure 20: Contacts searching

5.3.1. Respondents

Here is a tab that sums up characteristics of the interviewers namely: Organization, Business Field, Organization Business Role, Interviewer Role. Each interviewer has done one interview, except for Almaviva and Consorzio arancia rossa IGP which were interviewed together.

Organization	***Organization business field***	***Organization business role***	***Interviewer role***
MZBG	Beverages	Producer and Seller	Head of Northern Europe area
FoodChain	IT Solutions	Technology provider	Project Manager
Bofrost	Chilled product	B2C door to door seller	Head of Marketing
Lateria Valtellina	Diary products	Producer	Marketing Manager
Trufflemarket	Truffles	E-Commerce platform	Founder
Chocofair	Chocolate	Consulting Firm	Coordinator
Almaviva	IT solutions	Technology provider	Solution architect
Consorzio arancia rossa IGP	Fresh food	Consortium	President
Pietro Coricelli	Food	Oil producer	CEO
Pastificio Mancini	Food	Pasta producer	Head of Marketing
Pralina	Food	Producer	Marketing Manager

Table 5: Respondents

There were other interviews performed to the Head of Quality Supply Chain and Blockchain Product Owner at Carrefour), the Councilor for Agriculture, Food and Green Systems, to the Founder of Meracinque and CEO of Fileni. However, those use cases where not relevant to this study, so they were not analyzed in full. Some citations have been used where it was necessary.

Respondents included key actors from different step of the supply chain and different business areas namely producer, retailers, and sellers from online and offline channels

Here, a recap of the main details is provided:

Interviews period	*May- July 2021*
Total people interviewed	15
Total number of interviews	14
Total interviews time	494.36 min
Average interview time	32.95 min

Table 6: Interview details

Here a list of the interview's duration for each of the interview:

Organization	***Duration (min.sec)***
MZBG	29.27
FoodChain	74.09 + mails
Bofrost	29.02
Carrefour	22.14
Trufflemarket	32.31
Chocofair	78.13
Almaviva	33.46
Consorzio arancia rossa IGP	33.46
Meracinque	28.14
Pietro Coricelli	Written form+ mails
Pastificio Mancini	32.38
Pralina	21.02
Councilor for Agriculture.	32.39
Pastificio Mancini	32.40
Fileni	14.04
Latteria Valtellina	29.11

Table 7: Interviews' length

5.3.2. Interview structure

All the interviews were semi-structured. The underlying reason behind this choice is straight forward: firstly, they are very useful when collecting information on a high level of scope such as the one of the theses. Secondly, when it is not possible to design a list of pre-codes because only little is known about the specific area, and this is the case since as it is emerged in the literature review there are almost no researches trying to address such concerns and most of the application are almost novel. Moreover, semi structured interviews has another key advantage: they admit the researcher to add information gradually gained during the interviews and depending on the role of the respondents, made adjustments on the asked questions. Indeed, a key feature of theory-building case research is the freedom to adjust during the data collection process. These adjustments allowed the researcher to probe emergent themes or to take advantage of special opportunities which may be present in each situation. Thus, if a new data collection opportunity arises or if a new line of thinking emerges during the research, it makes sense to take advantage by altering data collection, if such an alteration is likely to better ground the theory or to provide new theoretical insight (Eisenhardt 1989).

5.4. Coding

After been recorded, all the interviews were transcribed. This allowed the researchers to better analyze the concepts to support the shift from data to claims. After that, to better foster comparison among the different interviews the main steps of the analytical approach are following described. According to Gioia et al. (2012) the analytical approach is the process of examining and analyzing transcribed data line by line, looking for specific events, experiences, variables identified as "concepts."

1. Extrapolation of the main sentences: starting from the transcription of each interview, each part of the interview was classified by assigning it a topic and a theme. At the end of this process, topics and theme were analyzed and redundant affirmations were removed. The overall idea, according to

Eisenhardt (1989) is to become intimately familiar with each case as a stand-alone entity. This process allows the unique patterns of each case to emerge before investigators push to generalize patterns across cases. In addition, it gives investigators a rich familiarity with each case which, in turn, accelerates cross-case comparison.

2. First order analysis: Label and themes were analyzed to understand patterns among the different interviews. In order to avoid the loss of important insights, the extrapolation of the same words of the interviewee was kept remaining adherent to the empirical evidence.

3. Second order analysis: the data were combined to perform within and cross-case analysis. First, each case was singularly investigated, to understand the main characteristics of each company; then, a cross-case analysis was performed, to compare among different cases, and to answer the research questions.

Chapter 6 - Results

6.1. Within case analysis

6.1.1. Foodchain

Foodchain company s born to offer solution for the food industry, and, in particular, it is interested in providing a good instrument to allow Italian companies to leverage their "craftsmanship" and demonstrate their product superior quality by certifying all the production process. Blockchain plays an important role for product differentiation in companies with superior practices and quality. "Producers therefore with a superior quality product try to demonstrate to their customers this characteristic, by phasing space between the competition and having a differentiation lever with respect to the others." Let's think about pasta for example. There is almost no possibility of competing in the same segment of Barilla, since it has long term agreement with GDO, a strong and established brand and a competitive advantage on cost due to huge volumes and extreme efficiency on the production processes. For this reason, to compete on the market they are only able to play on field where the product differs significantly for the average standards. However, they also must compete with those industries that tries to position on the same segment Blockchain is the enabling technology can play an important role to differentiate the product by certifying provenance and production processes, both on the business and on the consumer side. But it is not the only advantage, since it is able to create different opportunities:

-Offering traceability with blockchain create a secure, transparent, immutable and tamper proof way to certify information on the product. This can open new business possibilities, which otherwise wouldn't be accessible due to:

- quality standards: "Piper placed information for a particular rice planting technique on the blockchain. This type of traceability made it possible to demonstrate that the selenium level inside the rice was below a standard

threshold and in turn this allowed them to access a market that is that of products for children”

- possibility of certifying provenance:” Lynix has partnered with Marchetti for the first "tracked" ice cream. This is the testimony of how a company that communicates the quality of a product (Marchetti ice cream won the award as the best ice cream prize in Italy) can open new business opportunities (including B2B) of mutual benefit. In this case, the traced coffee beans used as an ingredient for the coffee-flavored ice cream had a significant impact on the perceived quality of the products: customers appreciated being able to see where the raw material came from and how it was processed and associated this modus operandi not only with the taste of coffee, but also with all other tastes, thinking that the approach was the same on all raw material.” Effort was made to certify the provenance of the ingredient since “it is not enough to say that your product it Italian, but you have to show you customer that you can proof that information”.
- Brand and company awareness: “At the moment, anyone who implements blockchain technology has an advantage in terms of image return given the novelty of the technology, which businesses that implement it can exploit. There are those who stop at this and there are those who continue to have advantages because they continue to invest in this solution and do not stop at the mere return of the image.”

- Access to public funding: “We are witnessing big efforts and big funding that are coming from the European community or from state investments of the PA for this technology: in some public tenders, for example, blockchain technology is expressly requested. Implementing a blockchain technology enables to participate in some public tenders which otherwise wouldn’t be accessible” This in interesting if we consider that for 2021 the fund for technological innovation in the agricultural field was about 500 million.

- It modifies the relationship between parties, for example producer and sellers in the supply chain. There is no more need in assessing the trust on the information provided, since the trust relies in the technology “This therefore modifies in some way the relationship of trust between the parties, and this is one of the key points is the change between centralized systems towards decentralized systems. Until now the actors are masters of their own decisions and if you want to access the information you must ask permission from the actors who can accept or refuse to provide it, therefore even with the power to provide only a part of information selected by them and therefore by nature not complete and transparent. the trust is therefore no longer the third party, but towards the technology itself "

- May affect the relationship with GDO: “While in the first case (blockchain required from P.A. ed) it will still take some time, the latter (GDO) is much more frequent also about large-scale distribution. The trend is to increasingly abandon what are paper documents to approach what is a higher level of security. Although the regulatory framework is not yet ready, the push is coming from the bottom as companies have requests and the technology that has been identified as the most suitable is precisely the blockchain.”

On the other hand, regarding MNCs which has complex systems with different actors and supply chain, implementing a blockchain can improve operations efficiency by cutting time costs of different processes “multinational that works in the field of palm oil. It involved producers, transporters, government bodies, banks etc. When the bank and the smallholder are placed within a single system in which the information is not filtered by an intermediary, then the release of the funds also arrives immediately. Currently the process is much longer, as there will be 7 days for the small holder to have the suns and ship the goods, so the goods remained 7 days in the warehouses and caused delays throughout the supply chain. When the solution had put all the farmer's request together within the ecosystem and instead the release of the funds by the bank

would have been immediate, so even if the funds themselves were not virtually deposited inside the bank, the latter was registered in blockchain therefore it should guarantee the immutability, security, transparency of the transaction and this could send the goods and make sure that the funds have been issued"

In addiction it seems that a remarkable benefit on the implementation of this technology seems to be in the relationship with the customer. Company want to overcome the traceability standards of the industry to fulfil an increasing demand of traceability: " At the level of legislation, traceability is not so tight, while what the market currently wants is to go beyond legislation that is no longer so tight and no longer trust the brand or label that offers it to you" so they " choose an enabling technology to guarantee traceability and origin to the final consumer."… "Phoenix implemented a blockchain to track the processes but at the very end they used the collected information in the upper part of the supply chain to filter them up to the final customer." Moreover, according to the interviewee implementing a blockchain technology can impact on the loyalty of the customer towards the brand " In terms of slightly less tangible benefits, there is certainly customer loyalty as the company that plays open cards is rewarded compared to another company that does not give me information where the customer has an interest in knowing." and in the reductivity for the products "At this moment on the shelves of almost no product you can have a complete story. The products that have it, therefore, can have a price premium because they are able to directly communicate the added value to the customer."

To conclude here a statement from the interview is presented that summarizes the reason why should adopt the technology: "companies adopt this to enhance the communication of the product itself in the product itself, including a storytelling where the values and characteristics of what is inside the product are communicated not only to satisfy what the customers ask but also leverage on what technology can offer in terms of added value, as for example in the case of selenium it has managed to leverage something that was not the primary objective."

Despite the interviewer says that the maturity in the technology both for customer and businesses is still low, even if businesses tend to be more aware of it. On the other hand, adoption is increasing both in the public and private sector, so there will be a turning point in which companies will need to adapt to new standards "there will be a need of alignment to a level of standards that are not European, not national but global. If on the one hand we see that state and parastate administrations are stopping this technology and therefore standards will be born that must be respected by mentioning blockchains and distributed systems, those who do not have such a system will be cut off."

6.1.2. Bofrost

Bofrost is a German company of frozen food and ice cream currently operates in 12 countries. In Italy it is affirmed with almost 350 million turnover, 2400 employees and almost 50 subsidiaries in the whole Italian territory. Its business is exclusively B2C, since the products are ordered from the customer directly to the company which brings them with a door-to-door approach. It is currently the Italian market leader in the door-to-door market, which is done through the famous Bofrost vans, having the role to do the temperature-regulated transports directly to the customer. Moreover, it is the second payer for the category of frozen food in Italy. They implemented blockchain project to enhance the relationship and the communication with the customers: the company have weekly contact with the same customers, and it is easy to understand how customer loyalty is crucial in this type of door-to-door business. "For us it was certainly communication towards the customer, more a question of visibility and transparency from the company towards its consumers was necessary,". Since they sell high quality product their objective was to transfer such values to the customer by giving him the full transparency on the processes that confers the forementioned value to the customer. "…. everything that is our process, the fact that our products are excellence, and it was therefore a way of communicating quality and added value for customers". The choice of the product was done among two determinant

factors: the first was that the reference should have high volumes and the second was the supplier availability in undertaking the project “So we have to do it only for references that have critical mass… the greatest difficulty was in finding the right partner, there is no culture in the partners, which in these cases we already buy as a finished product (and packaged ed) and it is clear that when I go to ask to insert a sensor in the fishing boat or in the artichoke harvest it is a cost and for this reason we had great difficulties from that point of view.”

Moreover, regulation is weak and there is no traceability system imposed by the law. They want to overcome this absence of traceability standards by making it on their own using the blockchain, which was the enabling technology. “In the frozen food market, I do not find (because it is not required ed) any player who goes for a product to put what the temperature is, when it arrived, when it was fished, when it arrived at the office when it was shipped and there is no one which publishes all the analysis that are done on the products”. This enabled the company to achieve a competitive advantage from competitor: even if they may have such values, they are not able to proof them or transfer to the customer “For Bofrost it is a differentiating factor and a competitive advantage over its competitors”. Keeping in mind that all was done to enhance the relationship with the customer and deliver superior values, even if there could be other possibility to track their products, they choose to implement the blockchain since it was the only technology which by its characteristics could bring up to the customer the detail of information required by the firm. “The only one (system ed) that met the requirements of total transparency towards the customer was the blockchain, so we adopted that.” But which were the feedback they received from the customers?

Customer feedbacks were positive and blockchain the traceability was also a weapon on which salesman leveraged “We do not have a precise measurement, however, being a company that is in close contact with customers as our operators contact us weekly and receive our operators at home for the delivery of the goods,

I can talk about the qualitative considerations that come through the service customers and our salespeople who, for better or worse, on entering the customers' homes bring us back what are the considerations, which have been extremely positive. First of all it is a source of pride for the seller that Bofrost is so transparent and this becomes a further sales leverage for the seller, but also through the customer by giving him more security and perceived quality"

Blockchain traceability creates a safety hazard among the company "It was not something that made us sell more, among the two products we implemented , it was something that was more of an umbrella effect: the safety hazard was not limited to just the 2 products certified but it has also brought confirmation to non-certified products because in the consumer's mind if they do so on these products that are certified so will everyone, or in any case it is their way of working and therefore has a positive effect on the company which then it has turned into safety on all products." ….

It has increased customer loyalty and let the companies gain new customers" Certainly it has an impact on the loyalty of our customer, even we were not able to measure it". From the previous part it's interesting to understand how the implementation of a traceability system reshaped the relationship with the customer: by tracking two products, they were able to engage the customer by giving him reassurance on the product he was buying. But the advantages of implementing a blockchain where not limited to these aspects. A great importance was also given to the brand awareness and the consequent brand perception that was given by this project: "a transparent company is a safe company" and this was rewarded among different publishers, which in turn seems to have given a space in the mind of the customer, which later have chosen Bofrost. "The return of image that this project has had has been absolutely positive, we have had many press releases both in the more specialized press but also in the more popular press, so in terms of brand awareness and brand safety it has increased a lot. By heart we

have had more than a hundred press releases, and this has led to a very important effect on the brand. We have had an increase in customers certainly due to the pandemic, but I am quite convinced that they have turned their attention to Bofrost also because they still had an idea, feedback and a positive perception of the brand and therefore they found themselves choosing Bofrost."

To conclude here are presented some remarks on the impact this project had at he business level. First concerning the return of investment of the project: as the literature correctly points out, implementing a blockchain solution comes with high cost. By the way, the company was satisfied by the investment done, even if they haven't seen a sell-out increase in the two certified references. "The cost was high, but it was certainly covered by what we said earlier in terms of press releases and brand awareness. We would like to increase the number of blockchain certified references, however, although we have had an extremely positive response in terms of visibility but not direct sales on those two codes." Second on how the implementation of such project has shaped the relationship between two actor of the supply chain. Despite at first it was difficult to find a supplier to put this technology in place at the end both the company has benefit from this choice and it extended the relationship among the parties. "The greatest difficulty was in finding the right partner, there is no culture in the partners, which in these cases we already buy as a finished product (and packaged ed) and it is clear that when I go to ask to insert a sensor in the fishing boat or in the artichoke harvest it is a cost and for this reason, we had great difficulties from that point of view. And this is a short-sighted view, as for example with our two suppliers we have established a relationship of greater trust and at the moment we are not changing them nether we intend to do so".

Last question was related to how the interviewer this that this technology could take place. According to the interviewee some problem regarding the adoption of blockchain technologies are linked to the lack of culture of such field in the

industrial field, but he remarks that there are some businesses in which having a blockchain is a fundamental requirement for accessing certain business areas. “The problem is an industrial substrate that does not have that blockchain culture as for example in the United States, where this is a prerequisite. For example, some large-scale retail companies such as Walmart, as we now have a prc certification, Walmart requires a blockchain certification. At that point that becomes a standard. This is an important limitation.”

6.1.3. Mancini Agricultural Pasta factory

The Mancini farm is a different entity from the Mancini agricultural pasta factory, but both do not survive without the other: the farm has existed since 1938 and was founded by Mariano Mancini, who is the grandfather of Mariano Mancini the current owner. Hence, Mancini agricultural pasta factory has existed since 2010, since Massimo Mancini decided to add a further production step to the cultivation and sale of cereals, which was the business on which the farm was founded before. With Mancini agricultural pasta factory, the passage of transformation is added, that is, the circle is closed. The process starts from the sowing of the wheat and from the upstream selection of the seed from sowing to cultivation, and then pasta is produced only and exclusively with the wheat that has been cultivated during the vintage and this applies to every agricultural year, using exclusively the wheat coming from proprietary sources. The company is situated in Monte San Pietrangeli in the earth of Marche region, 35 employees and its revenues accounts almost in 30M euros.

The company implemented the blockchain traceability on the whole production process of their major product, the pasta Mancini in all their formats. The reason to do that where at the middle between having more efficiency derived by tracking the whole production process and the possibility to develop a new relationship with

the customer “So it is something that we have done on horseback, at 50%, both as an improvement within the company, and at the same time a new way to with the consumer. even if according to the interviewee the largest impact has come in the relationships towards the customer “even if to be honest we have had a great benefit as regards the relationship with consumers in terms of perception, both in the brand and in the perceived quality of the product”. In fact, BC extended the touchpoints with the customers and has facilitated the company in relating the particular brand storytelling “it is a positive innovation that allows it to tell even more about itself, and our particular story”… “this way of making pasta that looks more like that of a wine producer who has his own vineyard and his raw material, in his case the vines in our different varieties of wheat, and makes pasta that has a vintage and which every year is the daughter of a crop.”. This project was the certification on the choice made years before on the way in which the company wanted to distinguish “So it was the certification of a choice made at the time on a commercial level and today guaranteed by this technology that has made our philosophy even more true in the eyes of people.”

While, concerning the choice of adopting this specific technology, even if the company has evaluated different option blockchain was the only one that fulfils their requirement in the level of transparency towards the customer “yes, we have evaluated (different option ed), no we have not wanted because we are happy as we are. In the sense that the consumer, thanks to the BC, has the possibility to verify when he wants, where he wants his doubts.”

Now that the reason of implementing the blockchain were mentioned, it is the turn of understanding which where the outcomes that company was able to see on the project. First it is going to be presented the benefit which come in the B2B field, later the impact that this project has on customers with final remarks on the Brand/company level

B2B

Company evaluates positively the project among its business partners “first of all it was a positive experience” for different reasons. “The major benefit has come from retailers compared to Ho.Re.Ca channel “retail was the most interested compared to the Ho.re.ca channel or in any case that uses our product by opening the envelope and transforming it in turn, therefore the restaurant” and the reason was linked to the novelty and originality of such project “ because they (retailers ed) are always looking for news to communicate to their customer, which can be a new format, a new packaging etc. to keep fresh the attention to the customers”. This helped the company to enlarge their business customers base “certainly it was not the only factor, but being the only ones to have a blockchain certification has helped us to have new retailers” and changed the relationships between their business partner, since now they are obliged to meet company’s standards of transparency. This automatically push the supplier to be responsible towards the client “the mill, which is not a phase we have inside the company, in turn has a sense of responsibility because they too, despite being external, are involved under this magnifying glass.”

B2C

The implementation of the blockchain project has been extremely successful for the relationship with their customer. The major impacts came first from increased trust and enhanced loyalty among existing customers in this specific case, the type of customer is one who makes a conscious choice on the product he’s going to buy, because it has high quality but also higher costs to the customer, compared to competitors. The interviewee thinks that the fitting between consciousness of the consumer and companies’ values is crucial “Trust was certainly one of the aspects we gained most, but there is a small premise to make. In my opinion, beyond a question that could be formulated in a standard way to a company, especially if it is large, one can think about BC in many ways. In our case we have a company

that is already chosen with awareness by the consumer, because the positioning of the product we have is high and because normally the fact of having a company that declares itself an agricultural pasta factory already puts the consumer in front of it to a conscious choice, in which he appreciates also the idea that the raw material comes from or is known or manipulated by the same actors who make the pasta. Therefore, we improved the loyalty of people who already gave us trust". On the other hand the awareness and media attention that the company gains from this project, permitted the firm to gain new customers " but at the same time, however, we have had great credit towards those who were skeptical or who have heard of an agricultural pasta factory for the first time, therefore of a method that comes out of industrial or artisanal pasta, he has heard about it precisely because articles have come out that told of us and how we built our BC platform and thus we were credited in their eyes. There is a willingness to go and see what we do how we do it (by scanning the QR code ed) because it is an unusual thing (the company production process). "

The company was able to measure such impact from the data coming by the scans of the QR code, which the interviewee considered an elevate number and according to him the success was given from the implementation of this project and the communication plan which was put in place by the company to sustain it. "We had a high level of QR code scan, certainly because they have been combined with a fairly timely social communication of ours and will be growing because they are still arriving on the shelves anyway, we do not have all the packages that can now be found on the shelves of the shops already with the QR code. We have seen that people go and see all the pages, especially the page dedicated to traceability where they can learn about the 4 macro phases we wanted". Moreover, there is a remarkable factor: the company visited the section where there is the has of the blockchain transaction, even if of course is not possible to understand if people go there because there are curious or because they are looking for this information "The nice thing is that we have seen that even the '9 test' button, the

one where you go to see the actual transaction hash on the BC register, is also consulted a lot by consumers. Then, to say that it is pure curiosity or a question of trend, I do not know, it can be true both of them. What we see is that the traffic is still there and then it bounces in our site and in the various channels we have."

Company level/ Brand level

- Blockchain increased the value and the perceived image on the brand, enhancing its history and mission by the use of a digital tool in a industry which is static and with old practices "The Blockchain has certainly contributed to giving value to the brand and its mission. Let's say that in a world that is quite static like that of pasta, the fact that we had the BC technology and implemented it fairly quickly, allowed us to be able to tell and to open the doors even more on how we make pasta from an agricultural pasta factory, so the feedback we had in terms of perception was positive".

- It was useful to solve a perception problem around the company "Many times one could have a doubt which is: but is it possible that you can make all this pasta in a single company and that they are always the same actors? It has always been a commercial issue, a perception problem, not one of the biggest, but one that we have solved or buffered thanks to BC has been just that, being able to demonstrate and make sure that no one has to pick up the phone or reach us in person or to make fleas in the work we do in other ways".

- This project gains a huge interest in terms of visibility and give to the company a remarkable brand awareness, and this was noticed by the company through the various proprietary channels: "(the QR code) generated a tam-tam within the same social network. And then it was forced a lot by the communication and attention of journalists. So "il blog", "la nuovla del lavoro" , "il corriere della sera" e "Il sole 24 ore" borough us a lot of attention from consumers who came. Interactions on social pages have increased"

- Regarding the ROI of the project the company claims that the investment has paid off since it has benefit from in the short term, and he will continue to benefit from it. Communication was the key value from which company benefits “I think it will be repaid perhaps like all things related to the world of communication in a gradual, slow way. We will see this more and more in the long run. at the same time, I think there has been a short-term benefit, because we have had a lot of attention from customers and the trade press, but I'm not a specialist. In my opinion, the benefit and the economic investment can be said to have paid off easily, and I think we will continue to benefit from it in terms of communication, and therefore yes, we can consider it paid off.”

Before concluding this case study, here are some remarks on customer which can be interesting in understanding the kind of customer personas on which this type of project could be more efficient/beneficial. The perceived benefit o the technology seemed to be most effective in people aged below 30 y.o. and it was noticed also by the company in its salespoints

“Specifically, our audience is also quite younger than the average of pasta factories, we certainly have a group that is over 40 or 45 who always sees this type of tools with a lot of distrust, because it is not the generation that grew up with this. type of digital innovation and because it is impractical, so unfamiliarity often makes it go hand in hand with mistrust…. "Moreover, according to the interviewee, BC also had a somewhat controversial communication on the Internet does not help that type of public, because one always thinks that BC is something dark" to say BC with a certain type of public puts you a little 'in an embarrassing situation because especially over 45 BC it rhymes with bitcoin, cryptocurrencies, and you know how controversial that situation is "… “Yes, if we use the 'millennial' label, today a millennial comes to buy pasta at the point of sale and immediately scans the QR code, it does it automatically, as if it were an extension of the normal way of buying. So yes, it rewards him, we also see it in social networks, the news of when we went out with FB, with the IG of the

QR code available, I have not seen young guys back down who have commented 'beautiful, contemporary, in step with the times ...' . This is a fact”

6.1.4. Latteria Sociale Valtellina

The Latteria Sociale Valtellina, which was born from the experience of shift dairies, was established in 1969. It is a first-degree agricultural cooperative that deals with the collection and processing of cow and goat milk from farms located in Valtellina, Valchiavenna and Alto Lario. Today it has 110 members, almost all professional farmers, who every day 1200 quintals of fresh milk 100% Valtellina. They “have been suppliers for the biggest GDO company in Italy for forty years since they have good products and many certifications”. Together with region Lombardia an Aria they have developed an experimentation where they were able to put in blockchain all data and analysis for the traceability of their milk. The reason of this project driven 50% by the company which benefitted from the public found of region Lombardi” while the other 50% is given by the fact that Regione Lomabrdia want to take a step forward in the entire production system and the industrial fabric of Lombardy. At the same time, the regional entity wanted to satisfy the growing consumer demand for traceability “We (Latteria Valtellina ed) have good relations with institutions, therefore we are recognized as a reliable company, as a reliable cooperative that allows us to create serious relationships with institutions…; last but not least, a last project that we have carried out with the PSR, which is the reference tool for the funding that the Lombardy region makes available for farms, cooperatives, therefore the agricultural base of Lombardy, the project we have presented was selected by the ministry of agricultural policies for which we have benefited from almost three million euros in funding” …. “The project was launched as a market analysis showed that 71% of European consumers demand greater transparency and greater knowledge of the products they consume”.” The company has chosen blockchain since the project and the experimentation were focused on this system, but the interviewee thinks that there

would not have been no other possibilities “as far as I know I would not say that there were other possibilities to give such close traceability up to this level of detail”. Moreover, the company was able to implement the blockchain since it has all the necessary digital infrastructures to do so “ We already had a fully digital control structure, so we didn't have to make any economic efforts to adapt it. The difference was that that management system now interfaces with the blockchain and with all the players in the supply chain, from producers to consumers.”

Since this project has involved not only the company and the technology provider, but also many other direct and indirect stakeholders as the Public Veterinary Area of the Welfare Department and the General Management Agriculture, Food and Green Systems and Control and Certification entity it is interesting to evaluate not only the impact at a B2B, B2C and company level, but also the ecosystem level. Before going into detail there is a small premise that has to be done: in the B2B section there are going to be presented the advantages of this project for the focus company, in this case Latteria Valtellina towards other businesses. There are also some benefits that comes in the other way around, which will be presented in the ecosystem section not to so as not to make the discussion confusing

B2B

Blockchain have a positive impact on the retailers for different reasons: first retailer looks for innovative products, secondly because it plays a differentiation factor among the competitors and third being able to proof all the analysis, the quality controls and the intrinsic quality of the product in a secure and immutable way has a positive effect in the producer evaluation by the retailer. “certainly to provide for example of Esselunga ”… “all that is the mechanism of the structure, which is considered suitable for the quality level of the products they purchase and the transferable characteristics of their branded products affect the choice of the retailer. It is necessary to have the possibility to produce different products of their own brands, to have products that are required by the final consumer, and to have innovative products, hence the structure.

values, and having products in high demand by customers are factors that make it easier for you to be chosen over another competitor. Being the only ones in Italy in the milk sector to have developed a system capable of tracing all the processes and analyses carried out on milk gives us a commercial advantage. Although this is not the only evaluation parameter" … "the business customer, the large-scale distribution buyers who are attracted to this guaranteed traceability system, as these are things that consumers in turn require".

B2C

- Consumer has the possibility all the history for the product, from the milking of the milk to the packaging of the finished product, with all the necessary analysis "The way we built it, we are able to show the history of checks carried out by the PA on the supply chains, giving immediate visibility. This greatly protects consumers. They can access all the details of the supply chain, including the movements of each individual lot and the health checks required by the legislation."

- they have seen an increased number of cartons and customer pays more for the product. "yes we have sold more, especially in the period were experimentation was going on, but actually I cannot be 100% sure that was for blockchain." "But consumers are willing to pay more for a product whose origin they know and this impacts on the profitability of the product"

- Blockchain was able to satisfy the demand for traceability for customer (at least conscious one). "In the milk sector, big milk producer has lost part of their credibility. Moreover, the blockchain has the power to enhance the history, values and attributes of a product, which in this case was the "Made in Lombardy" with milk coming only from the mountains "Customers not only want to know about the quality of the raw material but also in the quality of what the processes are, which today the consumer requires for the big players

(Granarolo, Parma, etc. ..) who need to show that "virginity" that they have lost for a long time, so let's say that the blockchain allows us to emphasize and trace that territorial matrix that distinguishes us,"

- Blockchain helped the company to increase the trust and the knowledge of the company and on the product. This in turn can increase loyalty "the trust …" which certainly was grown in the consumer: in fact they would be consumer-customer, therefore the end user who uses the app and traceability to find out who the farms are, etc."… "the possibility of going back to the temporal collocation in an immutable way and to verify the validity with respect to the original data, increase the citizen's trust in the companies involved" "(Q: Did blockchain impacted on the loyalty from you consumers?) yes, it was a big leap forward in this sense for the company"

- Since the Latteria Valtellina's project was done in agreement with Regione Lombardia, this latter entity performed a structured survey in several physical points in order to understand which was the impact of application of blockchain technology among Latteria Valtellina's products. The analysis was done among two levels, namely professionals and consumers, but here only the consumer related data are shown. All the following data comes from Region Lombardia and were kindly shared from the marketing director of Latteria Valtellina who agreed for the use of such data in the related work. The surveys were submitted among 13 days, in 16 different places and was submitted by 6189 participants

1- Participants of the survey: there is clear evidence on the fact that the survey was made predominantly on consumer

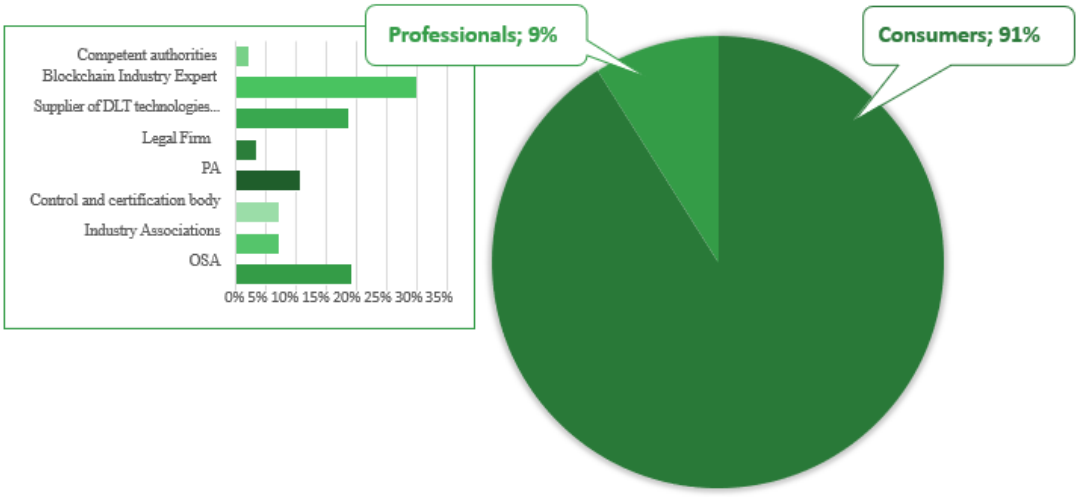

Figure 21: Survey participants

2- Information on the sample: There is almost an equivalence in the gender which submitted the questionnaire (almost 60% F 40% M). Respondents major cluster was between 35 and 55 y.o. accounting for almost 60%, while 26-35 surviewed where slightly above 15%. The rest was below 18-25 and over 65 y.o. The vast majority of respondents were from Milan, while all the other cities accounts for less than 10% of the respondents, except for Bergamo which is slightly above 10%. Regarding the educational background, more than 90% on the respondents had a good educational qualification, if we consider hat diploma is good and degree and PhD are excellent

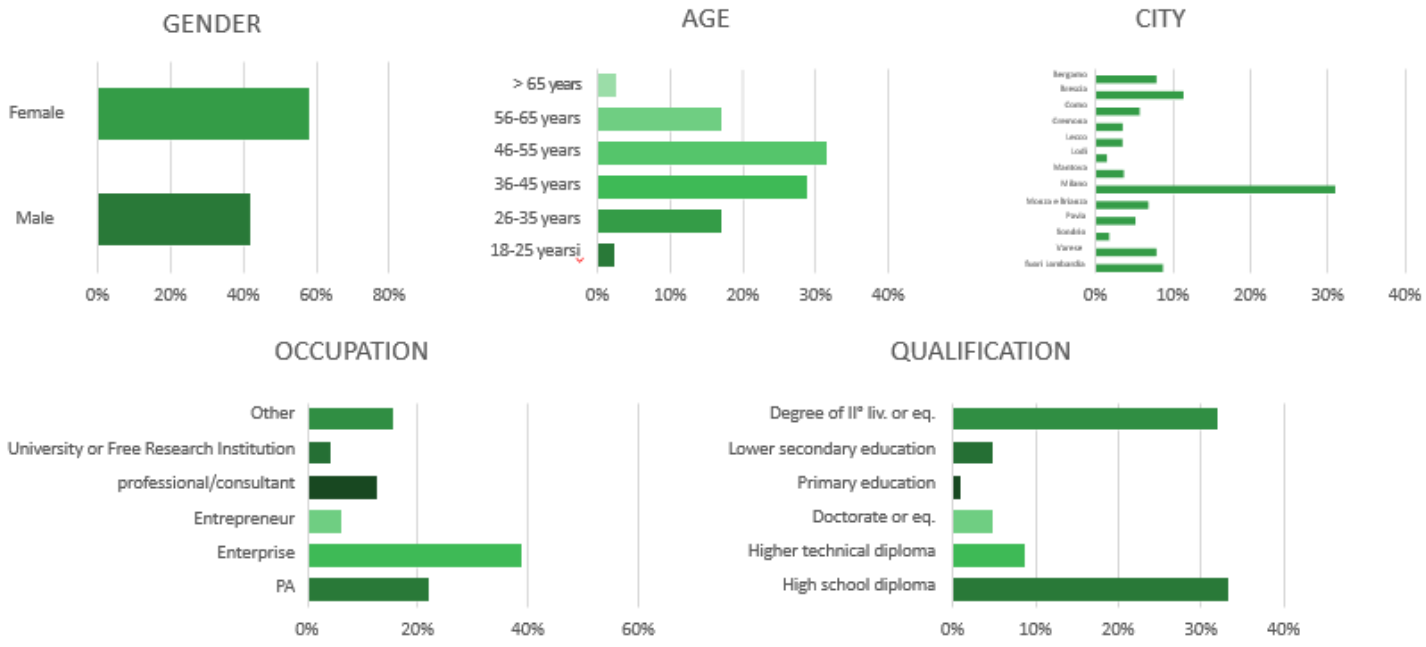

Figure 22: Information on the sample

3- Customer values: More than 40% values quality as a priority regardless the price, while almost 50% says that it is important but evaluate that in terms of value for money. Regarding the traceability of the products, 50% of the customer says that is a priority in their purchase intention, while slightly more than 40% puts also in place the value for money. Ethical aspects are the less values from customers, in fact only 35% says that it's a priority for their purchase regardless the price, while the large part of them seems to be interested but value money has to be considered.

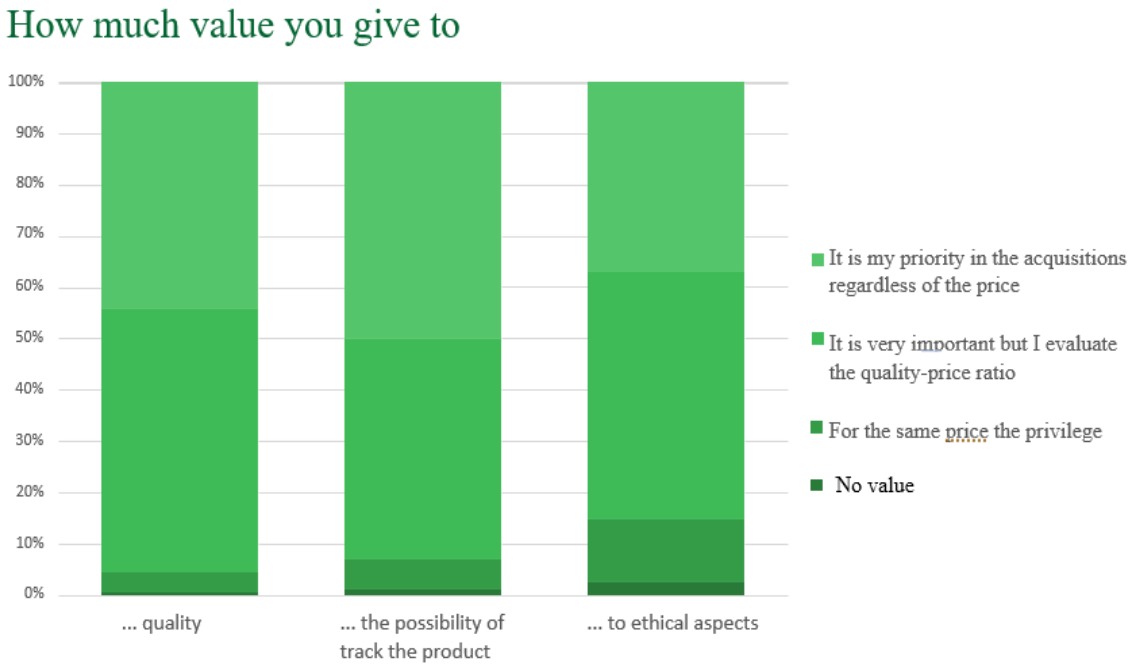

Figure 23: Customer values

4- Knowledge of supply chain processes: More than 70% knows or want to know more about the supply chain processes for milk production

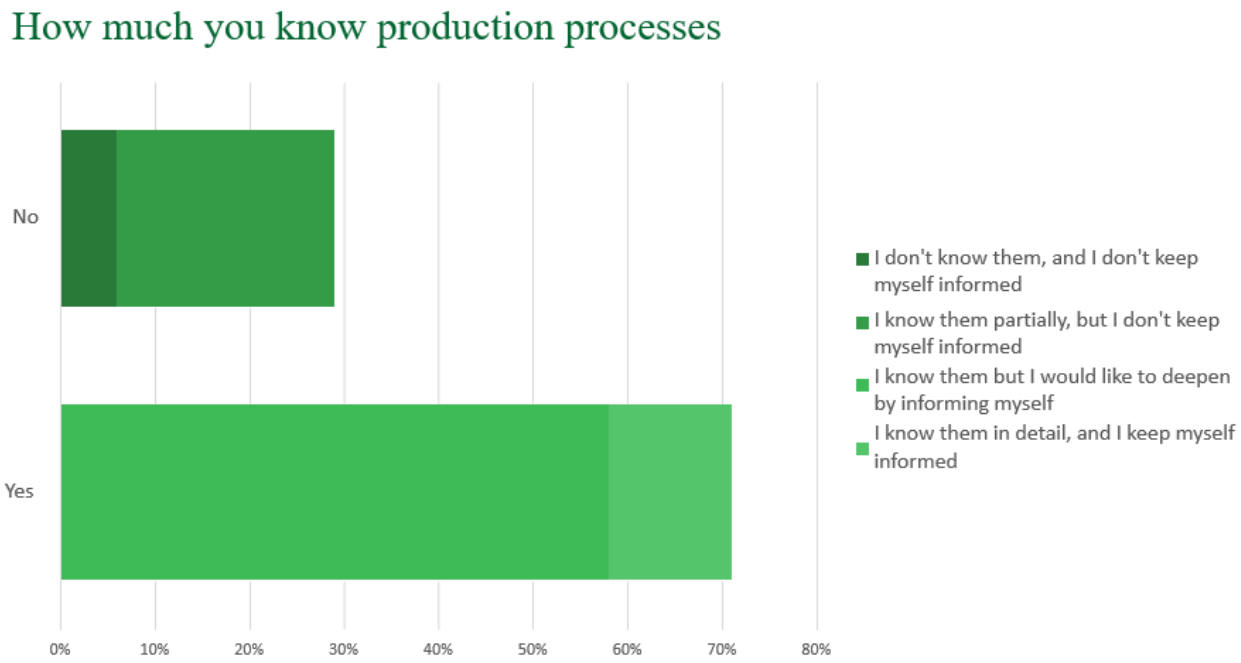

Figure 24: knowledge on the production chain

5-Importance of knowledge of production site, processes and origins of the raw material: over 80% of consumers says that having initiatives that increase the knowledge of the three forementioned parameters is very important, and this figures accounts in more than 10% for customers who says that is fairly important. Less than 5% of the respondents says that it is little or not at all important

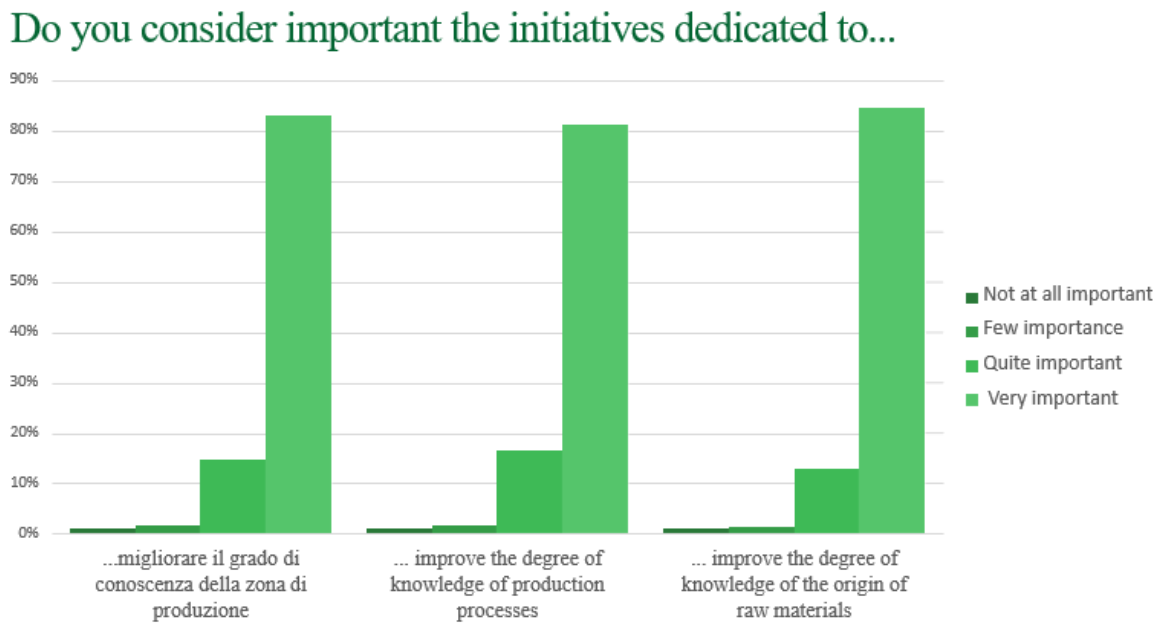

Figure 25:Importance given to the knowledge of production sites, processes, and raw materials

6- Blockchain knowledge: It is clear how blockchain among consumer is predominantly unknown, since almost 75% of the customer has from little to no knowledge of it. On the other hand, approximately 25% of the customer has a medium or good knowledge of the technology.

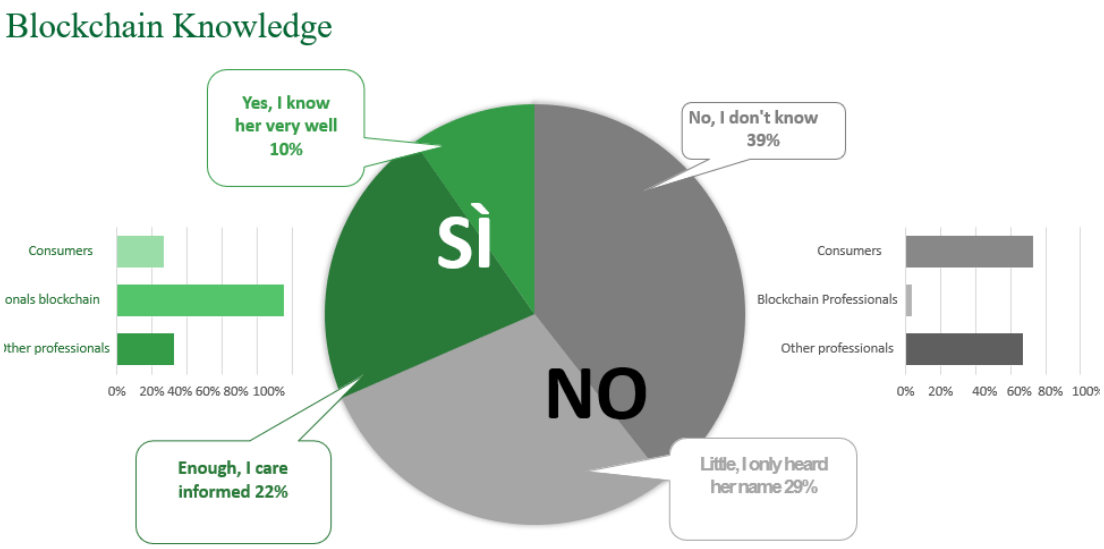

Figure 26: knowledge of blockchain technologies

6- Impact on the blockchain on the on the degree of trust in the label: Almost 25% of customer feel completely confident towards the label, while the vast majority, accounting almost to 55% of customers, is more reassured but not completely confident.

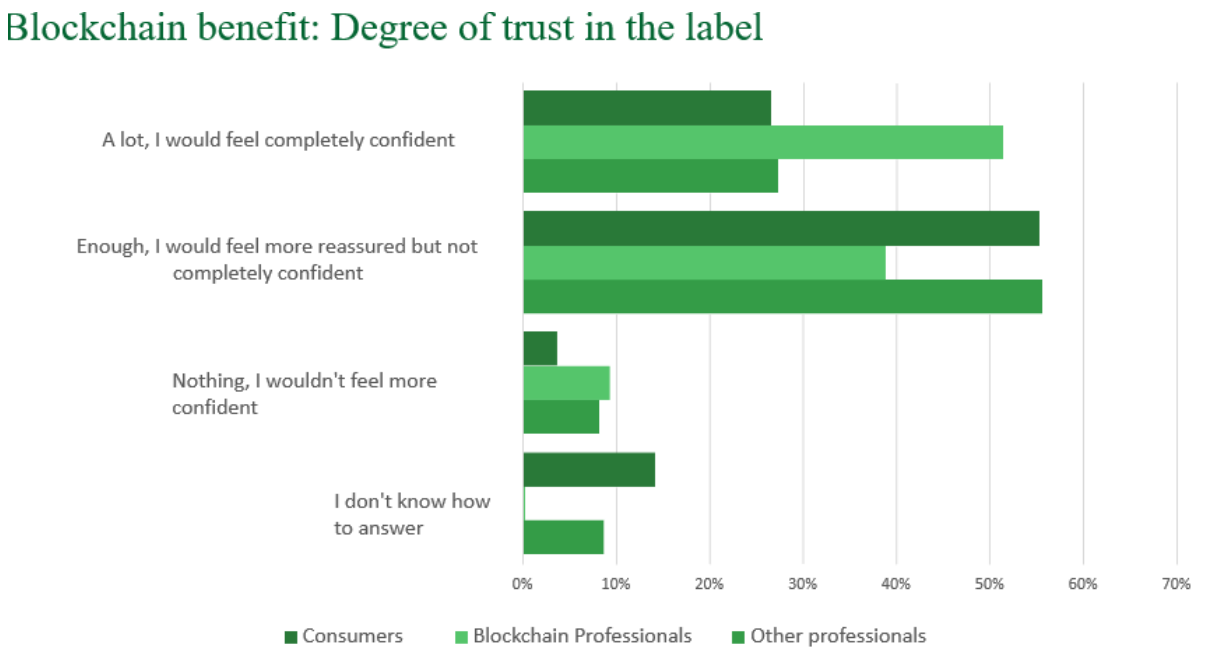

Figure 27: Benefits of the blockchain: degree of trust in the label

7- Perceived impact of blockchain in the production chain: Over 70% says that blockchain can guarantee the truthfulness of the information in the production chain, while turning into traceability the figure account for slightly more, around 75%

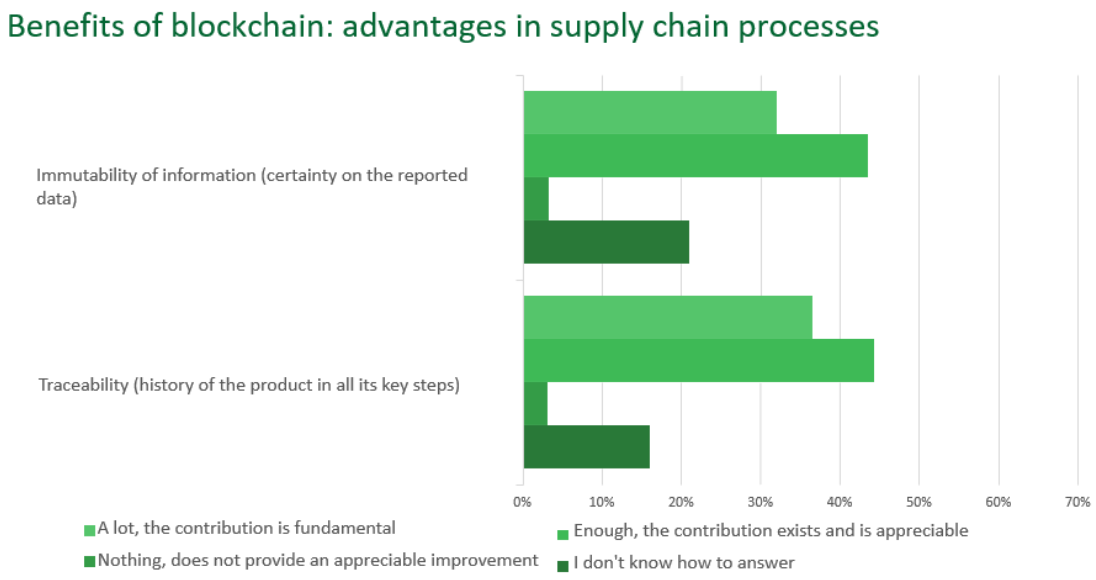

Figure 28: advantages in the processes of the consumer-supply chain

8- Usefulness of the app: more than half of the customer says that the app increase the trust in the quality of products, while almost 50% says that in helps in the knowledge of the product and on the product chain. This question was a multiple choice question in which the respondent could answer more than one choice. There were other options which are not presented since they are considered from the author irrelevant for the purpose of this study

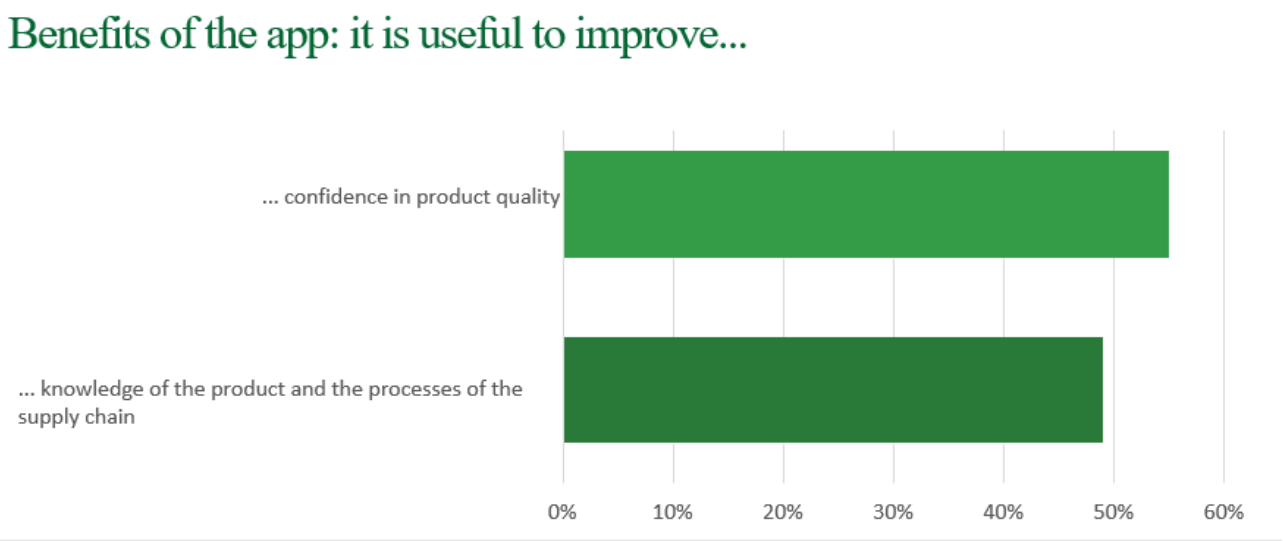

Figure 29: Web app benefits

9- Level of depth: it is interesting to notice that almost 10% stopped at the first step of the product details, while the rest went more in deep for understanding the other elements. This parameter indicated that customer were interested in knowing more about the product

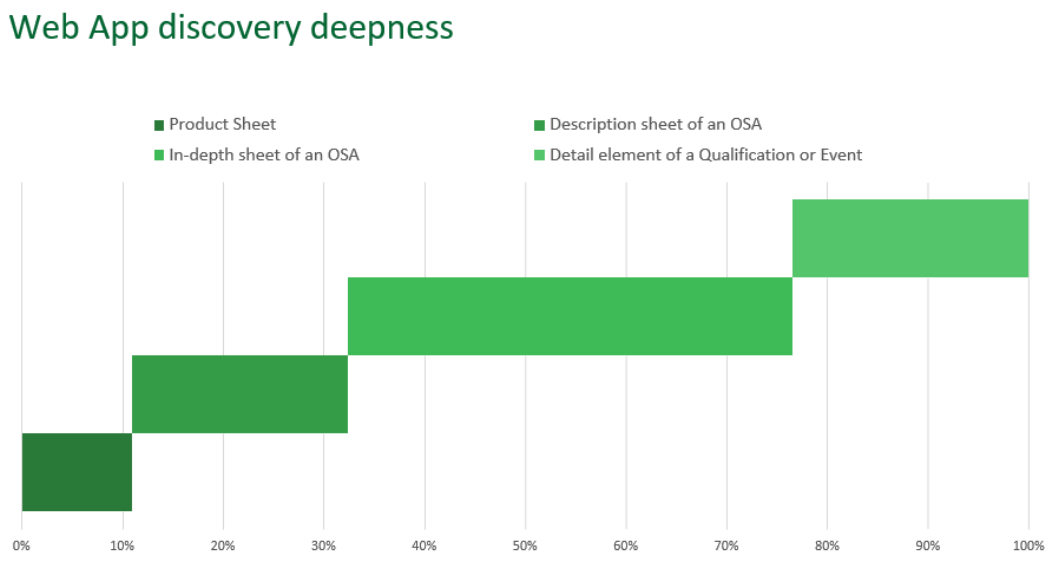

Figure 30: Web app discovery deepness

Ecosystem

- Implementation of blockchain technology has brought efficiency among the actor in the ecosystem: “This has certainly given us an advantage of efficiency. There are about 55,000 records in the veterinary sector that ATS compiles every year following the inspections they do, these will no longer exist. As the results will automatically update the regional archive and the business file of the individual companies.”

- Implementation of blockchain has increased the value in the whole system: “this means all these technological advances (the implementation of the blockchain ed.) allow the agricultural system of Valtellina to grow and make it clear that it is not only a milk pusher, but there is also a data infrastructure, of technology that must necessarily come forward to face the market, therefore also benefits to raise the level of the livestock system in the province of Sondrio.”…” in this project the value of the ecosystem has grown, both with regard to us and with the customer you have had greater transparency, which has certainly had an impact on the level of trust of our customers, on the other hand the ecosystem has also grown, as regards the farmers, the region and the businesses”

- Implementing a blockchain for agri-food traceability improve the society. “This is also reflected in a great benefit to public health, preventing the aggravation of some unwanted phenomena such as that of the antibiotic – resistance”

Company

- Implementing a blockchain has several repercussions on the perceived image of the company: first at the band level giving him a safety hazard, secondly it

helps the company positioning on the market. This in turn impact on differentiation, which affects reactivity. Consumers are willing to pay more for product in which perceived level of quality and transparency are high. “Having a whole series of controls and being able to try them on the blockchain gives us a strong impact at the brand level in terms of security and brand perception since customer are reassured when they rely on our company…. This allows us, but how it would allow others to better position us on the market as a company but also better position our products. As it plays an important role in product differentiation and this impacts on profitability "..." Consumers are willing to pay more for a product whose origin they know. "

- Traceability with blockchain helps the company to enhance its hallmarks and increase the loyalty “We are already known as regards our territorial matrix, the fact that ours are produced with 100% Valtellina Mountain milk but offering total transparency that the consumer can experience increases the loyalty of the final customer.”

- This kind of traceability can collect a large set of data which the company can use for marketing purposes. A figure below clarifies how this process works:

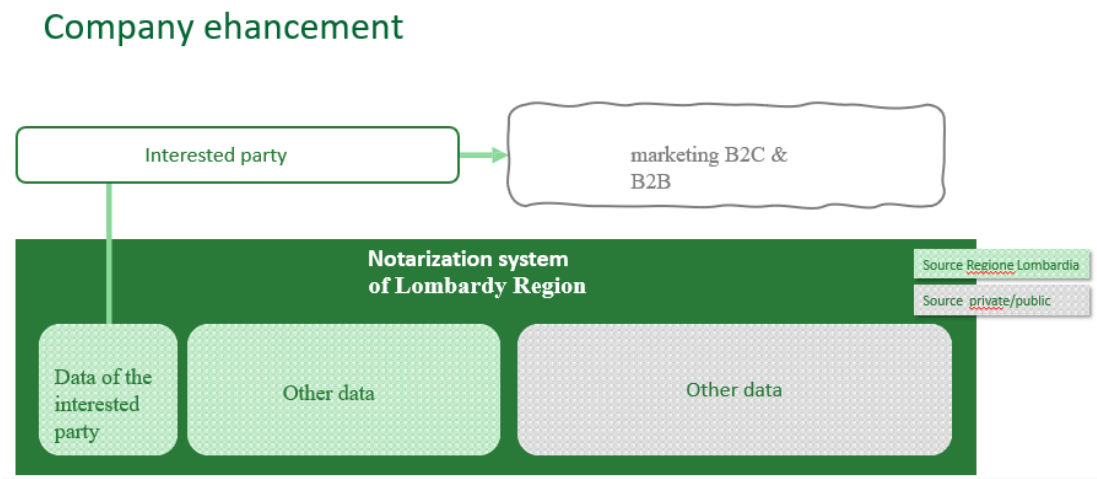

Figure 31: Data usage possibilities

6.1.5. Coricelli

Pietro Coricelli is the second player in the production and distribution of olive oil in Italy e among the largest oil companies in Europe, it exports to over 110 countries around the world, thus it represents one of the most distributed Italian brands globally. It in 1939 when Pietro Coricelli extra virgin olive oil made its debut on Italian tables, in Spoleto, in the heart of Umbria where is still situated the company headquarter. Their mission is to make known and appreciate the olive oil and the flavors of Mediterranean cuisine in the world while their values are quality of the product and service offered, ecological sensitivity, customer orientation, balance with the social context, efficiency and profitability. They are always careful to ensure the excellence of its processes, products and services, and adopts the most important quality standards applicable to food companies as: IFS - International Food Standard, BRC Standard - Food, UNI EN ISO 9001: 2015, FSSC 22000,Organic Products in accordance with CE regulation 834/2007, Kosher and Halal. These values are reflected among all their product, also in, the "Extravergine Pietro coricelli" which is the one on which the company implemented the traceability with blockchain. This product was the pioneer of the first project on traceability which was called "filiera Casa Coricelli" in which the customer could see all the steps from farm to fork. "With the birth of the first line of "Casa Coricelli" traced products, which tells the journey of Coricelli oil from the field where the olives are harvested to the shelf." By the way, the Blockchain project wanted to add a further step in this process of traceability: "offer digital content of tracked quality, maximum security and helping the consumer to make a more informed purchase choice". This further step - through the QR code placed on the label - allows us to have a point of contact with the consumer that we did not have before" which was made in order to show greater transparency and quality to customer " which was the main reason that led the company to embrace such project " Everything stems from the desire to guarantee maximum transparency and quality to consumers" Moreover the choice of the blockchain was done in

order to overcome the traceability standards given by the law, which the company considered not sufficient to enhance the quality of their product and for this reason they want to show all the steps that confer superior quality to the product. “The IBM project wanted to go deeper, because the origins of an oil are already clearly indicated on the labels by law, while the quality path that each oil passes before reaching the bottle must be the real must require by the consumer for safety and transparency.” Namely all the analysis the made to preserve the quality “(chemical-physical analyzes, panel tests, etc.) which thus become an immutable identity card on the product”.

At the strategic level, they choose to reference the most sold SKU in order to let all the customer understand the company values and their way of working “We have also chosen the best-selling and distributed product precisely to ensure that all our consumers can access the certified reference. Moreover the company believes that through this technology that can create a digital ID on the product which increase the customer perceived quality which in turns affects trust in the company “"Blockchain technology offer errs added value as it gives the consumers the opportunity to access numerous contents on the product that they find on the shelf and thus be able to choose with greater awareness the extra virgin olive oil to bring to their table. All this gives a greater guarantee of quality and increases the confidence of our consumers”. Another strategic reason was that the company, thanks large volumes it has could teach the customer how to recognize the parameters that distinguish a quality oil “We think it is essential to make consumers understand which are the safety parameters that must be monitored in an oil, in addition to what is not already provided on the label. Our dream is that this project can lead the way for a cultural growth of the category. The choice of blockchain was driven also because the implementation of this project is a differentiation factor in a traditional statistic industry and achieved a great impact in terms of credibility and awareness “We immediately received important praise from our partners, suppliers and customers. Ours is a traditionally static sector.”

and this novelty has conferred to the company a great impact in terms of credibility and brand awareness, also because traceability is something required by the customers ..The whole path of sustainability and transparency that we are pursuing has a strong impact in terms of brand awareness and credibility, there is a lot of attention on these issues, today even consumers are much more sensitive" To conclude, even the project has just started the CEO believes that it is going to pay off since it shapes the perception of the brand, its reputation and enhance the company-customer relationships " We are sure it will be rewarded, perhaps not so much from a mere commercial point of view but certainly from a reputational point of view: a transparent company is a safe company. Trust is the basis of every relationship, and for us as a family, having the opportunity to welcome our consumers into our circle of values is crucial to building the future

6.1.6. Truffle Market

Truffle market is an e-commerce for the sale of truffles that was born from the need to trace the truffles that grow in Italy. This initiative aims to enhance the value of Italian-made products, to tackle the black market and bring to the table a traced product of guaranteed origin. Ministerial data show that until 2019 there were 42 companies registered to market truffles. It can be estimated that in 2018 the world truffle market was worth around 300 million dollars. The truffle market shows very promising growth forecasts for the coming years, with a projected CAGR of 19% between 2018 and 2023, and an increase of $316 million between 2019 and 2023. [Technavio]). Given the size of the business it is easy to see that over 90% of the market is part of the black economy. In fact, there is no data on the number of truffles sold in Italy, nor is it possible to know how much was found. According to the interviewee, "at the alba fair, over 90% of the truffles are not really from alba and a large percentage are not even Italian". There has always been a problem related to the origin and traceability of truffles, as '"The traditional traceability system for truffles is a system that does not

believe in it, given the indications of the Governments, since it really allows not to trace the truffles at all.” In fact, Regulation 543/2011 - EU states it is possible to omit traceability requirements for: - Fresh uncultivated truffles - Truffles intended for industrial use - Truffles sold directly to the consumer for direct personal use - Truffles subjected to hulling and cutting operations to make them "ready for consumption" or "ready to cook".

A well-known case is that in 2019, when around 300 kg of truffles from Africa were seized in Bologna but were sold as Italian products. Another recurring problem is that of product quality swapping: "for non-experts (private consumers, ed.) it is very difficult to distinguish a prized black truffle from a summer truffle, and there are often websites that take advantage of this". Truffle-market was created with the aim of guaranteeing the traceability of truffles by using blockchain and thus going beyond the legal traceability requirements. "All products for sale on the platform have been found by truffle hunters registered with the Italian Truffle Hunters Association, who must follow strict standards to guarantee the origin of the product. Each truffle hunter is registered with ANTI, and must certify their residence, the area in which they are found, and the time and date of the find. Then the truffle hunters must upload this information to blockchain and when a customer buys a truffle, an NFT token is created that certifies its provenance." Although the system is not perfect (which would be impossible to set up anyway given the structure of the market), as it relies on self-declarations, this protocol as well as being much more stringent than the law creates an immutable record of all transactions. "So, while it is true that a quarryman might declare a forgery, he is aware that this forgery will remain indelibly marked." The total absence of certification of origin makes the consumer wary and the company has implemented this traceability system precisely to meet this need, which gives an important added value to the consumer” Blockchain was used to give added value to consumers, because in this way the consumer has the guarantee that the processes are established in the predefined times and ways, going beyond the normal legal standards. This system is not required by the law, but by the customers which currently runs into

fraud" … ". But the minimum traceability requirements imposed by the Italian state are truly minimal and are not sufficient to satisfy the demand for certification of the origin of the global market."

Indeed, this new certified system of traceability was a key differentiator in creating value for customer, which permitted to the company to increase the customer base dramatically. This can be seen as a symbol of trust, since according to the interviewee customer chose Trufflemarket for the traceability with blockchain. "From the consumer side it was a great success, the feedback was incredible. there has been a clear difference since we implemented it and the answer has come in numbers. From the moment we introduced the blockchain and made this public, we have had a peak in users and use of the app, which obviously also affected the number of sales. We are talking about a 10-fold growth in the user base in a few months. All food enthusiasts knew they had found a way to buy truffles that was truly Italian and that I had opened yet another site vendotartufo.it. So, it's obvious how consumers rewarded us precisely because there was a blockchain, it was the predominant factors. Obviously, the user-friendly app did its part, obviously quality and price did their part, but what made all those users sign up and we really increased the CB tenfold was the introduction of traceability on the blockchain. there is absolutely no doubt on this." The advantages of this technology were not limited to the customer, but also to the other side (in this case mortisers) and the society in general, thus the whole ecosystem of the chain "Although the truffle hunter has no interest in paying taxes, the truffle hunters who sell a truly Italian product have an interest in certifying its origin. For this reason, after a first moment of distrust we had several requests for registration, as it allowed them to access a certification and a type of market that would otherwise be impossible to obtain. Although it is a burden on truffle hunters, this guaranteed effort is required by the market. The blockchain gives us the possibility of having more rigid but most of all more functional tools than the law… "…." Customer joined since they are looking for product from certified origin" and in this sense has solved the chicken egg problem for a platform.

For the focal firm, Blockchain was a differentiating factor that created a double advantage: first it was able to increase the price of the product, since customers pays a premium price and second to cut intermediaries “

“For us it was a differentiating factor because so many frauds are consumed on products” … “As there is no other way to certify the origin, customers are willing to pay a substantial price premium which is what our project is based on” … “ they were willing to pay more for a product on our website rather than through other ways. As for DOP certification, a carrot with a stamp is worth more than a carrot without a stamp. With the difference that in this field a certification does not exist, but we have created a digital one (NFT ed)”.

Moreover, it has changed the experience of customer purchase:” before the only possibility of buying truffles was by change of hands, without any certificates and no guarantees while now the traceability system has allowed to create a digital certificate (NFT) that guarantees the provenance and the authenticity of the product “Experience has changed in the sense that he now orders a product with more security and more guarantee and receives together with the product an NFT token on blockchain, which is the equivalent of the DOP sticker. And this is the only possibility of having a certification.”

6.1.7. Pralina

Pralina SRL was born from a dream from a group of young people, mainly composed of women, with an innovative vision and a deep-rooted love for their land: to protect and enhance the resources of Salento, the extreme edge of Puglia. The idea of transforming local raw materials into practical and versatile products, and thus bringing the Salento culinary tradition into modern life, has become a project and then an innovative reality loved all over the world. Among the distinctive features of this reality, we find a dynamic company that pays attention to the environmental sustainability of the entire production cycle, in step with the needs and contemporary lifestyles, with a valuable know-how and ready to satisfy demanding and aware metropolitan consumers, oriented to ready to eat products. Its panel of products varies from sauces, pates, pasties, soups, velvety soups to baby food with fruit and vegetables. They have a production capacity of 16,000 kg of product per day, where the food safety of the finished product is ensured by thermal pasteurization and sterilization cycles through an industrial production process that minimizes waste and meets the highest international standards, certified annually by the Global Standard for Food SAFETY. Hence the desire to launch a line of soups, the biodiverse creating an integrated and tracked supply chain, which unites the young farmers and the company with a true protocol of understanding, with the' aim of creating natural products of the highest quality usable in Italy and abroad. The chain traces and promotes agro-biodiversity and culinary excellence typical of the territory, respecting all the economic actors involved. With the support of the startup FoodChain they have traced the production of creams and soups through Blockchain technology. The consumer with a smartphone the QRCode on the label of single-portion products and will be able to know: the place of cultivation and the raw materials used, the name of the producer, the method of preparation of soups and velvets, the ingredients selected, the recipes used, the date on which they were labeled, packaged, and shipped.

The blockchain has been implemented for a question of transparency towards the consumer, trying to emphasize the relationship between the company and the consumer, building customer loyalty "All this in order to adopt a choice of total transparency towards the consumer and establish a relationship of trust with him".

highlighting the special features of the products and the history of the project behind them "to enhance the particular characteristics of a production that stands out for its local area and the history to which this project has been applied"... "given that the basis of this company and social project is the recovery and enhancement of the area in which the company is located and its natural and human resources"... "For us, technology is a tool that serves to ensure the transparency of the company towards the consumer and therefore to build loyalty and intercept it".

In terms of efficiency, the implementation of this technology was not necessary, as the company already had management systems capable of tracking information. The effort was made with a view to making this information available to the customer, who is the real beneficiary: "In fact, we already have all the automated processes, we already have a management system, an EPR that traces the entire manufacturing process from the arrival of the raw material in the warehouse to purchase, arrival in the warehouse, storage, unloading for production, sterilization, labelling and dispatch. We simply made visible through an interface what was already happening at business process level. The blockchain then hooked into the management system and extracted the data, which was then made available to the consumer." The choice of blockchain is due to the fact that, according to the interviewee, it is not enough to be able to declare information autonomously, both as regards the consumer and the business world: "We could certainly declare, but we would not be inside a blockchain system in which every change is traced as a change within the system. So, any change, apart from being frozen in time and therefore not refutable, is tracked. In a traditional system I declare what I want ... The Blockchain, in fact, is not a system owned by the company, but public ... Any

change made on the management system remains visible to the consumer and the business world”

In addition, for the success of the project, the company implemented a communication strategy that would enhance the blockchain project, transparency and enhancement of the territory. “We may have done communication on these issues, namely on the concept of transparency, short supply chain, traceable supply chain, proper nutrition, raw materials, quality.... It is important because it allows you to talk to the consumer and make him understand that what you are doing ... we communicate through social media and through our communication channels of this project (blockchain ed) that keeps the whole territory inside. “

Now that the reason of implementing the blockchain were mentioned, it is the turn of understanding which where the outcomes that company was able to see on the project. As usual is going to be presented the benefits which come in the B2B field, B2B with final remarks on the Brand/company level

B2C

Concerning consumers, the company was not able to provide feedback as soups are a highly seasonal product, the project started in November 2019 and was designed for a well targeted consumer market, which due to the pandemic was not able to access the references indicated "Consider that it was launched in November 2019, just before the lockdown. This one we applied the blockchain to is a highly seasonal product (September to March/April), being soups and velvety soups, and was designed for a food-conscious consumer with little time to cook, so a 24-hour consumer at work. Because of the lockdown that forced us all to stay indoors, they have stopped a bit.

B2B

At first, the peculiarities of this project had created interest from retailers, which was then stopped during the pandemic "A series of supplies were starting but then stopped with the lockdown".

The blockchain project had opened up new business opportunities in a non-core sector for the company: "We were also invited to participate as a food company in the Florence Tourism Exchange precisely because of the application of blockchain and how it can connect, even if applied to the food system, to the story of the territories, since tourism and food can interact with each other."

-The blockchain creates a competitive advantage with regard to exports, as some international business players require it or at least influence their choice "to make it available to any private label of quality that want to certify the production Made in Italy. Blockchain, in fact, has another great advantage in that it can be a tool against the various counterfeits of Made in Italy in the world. This is increasingly in demand... "It is certainly a choice that we have paid a lot of attention to".

Company/Brand Level

- The implementation of this project has had an important return on the brand and on the company's reputation. "We were even included among the 10 case histories of Microsoft, which created a project called Restart Italia, linked to the restart of the Made in Italy agri-food sector after the lockdown phase last spring. All this has certainly contributed, and the brand has benefited."

- The company has benefited in terms of brand awareness and from

consumers sensitive to these issues. "Despite this, the interest in this product thanks to the blockchain has been high, as it has received considerable attention from the press: "we have been published in 'cucina italiana', TGcom24, Repubblica, Wired" and in ecommerce by those people who are sensitive to the issue of traceability".

Final remarks

- Blockchain as a competition lever. Blockchain is a powerful tool that enables small companies to compete against MNCs since it enables to track and certify the superior quality and processes of excellence for conscious customers "So it will certainly be an important watershed for small companies that can find in Blockchain a tool to certify their quality also against large multinationals that can afford to have the Blockchain but at the same time to have a core business that does not meet at all the criteria of transparency of the Blockchain. It depends a lot on the power consumers want to exercise. “

- ROI: the company evaluate positively the investment which has been made on blockchain "It will be paid back for sure and maybe in part it has already been paid back, but for sure it will increase because the awareness will grow because there are big brands that are already introducing the Blockchain, and this means that the market is already moving in that direction."

- customer comprehension of technology: Consumer comprehension of blockchain is low but it is steadily increasing " (the technology is ed) Not completely (understood ed.) because there is not much education on Blockchain, but definitely it is something that will grow in a short time because all the big multinationals are looking at it... but from what we can see, the maturity of the consumers is growing".

- It has great potential for valorization of excellence "As already mentioned, it also has enormous potential for the valorization of places, territories and companies. "

6.1.8. Chocofair

ChocoFair is a network of supply chain consultants aimed at ensuring a secure and traceable supply of quality cocoa produced with respect for the land and people. It was set up in 2013 with the aim of allowing cocoa producers to enter the European chocolate market directly - guaranteeing fair remuneration, respect for labor and sustainable development - and giving European chocolate and ice-cream makers access to a high-quality product, with the aim of highlighting the tangible advantages of supply chains that start from farmers. This is because, according to the interviewee, "an underpaid and exploited producer has no interest in specializing in the improvement and quality of his product" and "the secret of a good chocolate is a quality raw material, and there is no quality where there is systematic exploitation of people and labor. to make a high-quality cocoa, you need a high-quality chocolate". the blockchain project has been implemented on the ivory coast, where one of the processing companies with which the company collaborates is located. Although the blockchain project that the company has implemented is strongly oriented towards the business sector, the consultants of chocofair work with a large number of national and international cocoa companies, so the interviewee also gave us some considerations regarding the B2C landscape, orienting it towards his area of expertise, that of chocolate

B2C

- In the chocolate sector the traceability of the finished product (the chocolate bar) is not necessary as the consumer has no interest in verifying this kind of information. "in our experience, the end user has a very low propensity to ask for traceability in this sector... rather they are very sensitive to marketing strategies where there is unsupported information.... An example is the APOLLO tablets in which there was a picture of a woman from a cooperative associated with this project. It simply said that part of the proceeds of the product went to finance a small women's cooperative that made soap from cocoa waste. On the real issue of cocoa, i.e. to have paid better for the raw material, the origin, quality, how it was grown, by whom it was grown, there was absolutely nothing" This compared to an analysis that was done by the same company on a sample of consumers whose characteristics characterized them as aware consumers, but who in reality had no interest in verifying the type of information on that type of product (in Italy) "the sample of consumers that we have intercepted and on which we have done an analysis, were people who were sensitive to the issues of fair trade, fair trade and things like that, but had not bothered at all to go and see the correctness of all the information that we said before (i.e. to have paid better for the raw material, where it came from, its quality, how it was grown, by whom it was grown) they believed that it was so, although it was not so...".

- According to the interviewee, a consumer's interest in tracing information is closely linked to the knowledge he or she has about the product: "in our experience, the Italian consumer is very ignorant about chocolate and does not exceed that threshold... and we are not just talking about discount consumers, we are also talking about consumers who are a little more sensitive.... our business is developed in a large part for the fair-trade market and as much as it seems a paradox, those consumers are the ones who know the least about it...

"at the end the parameter they use is always that of price, they are not interested in the origin"... "they have little inclination to perceive the quality of the product" and what is really there 'inside ...

- According to the interviewee, a consumer's interest in tracking information is closely linked to the knowledge he or she has of the product's quality process: "in Italian culture there is no perception that chocolate is a product of Italian food and wine ....". And this way of making chocolate is extremely linked to the traceability of the product, as much as wine, so is cocoa and chocolate"... "in the Italian consumer this awareness is not there"... so right now the Italian market is not able to understand the blockchain tool on chocolate because it is not sensitive to those issues"...

- According to the interviewee, the interest of a consumer to track information is strictly related to the belonging of a product to its culinary tradition: "it works on pasta, it works on oil, it works on coffee or on products that the Italian consumer recognizes as part of its culinary tradition".

- There is evidence that the implementation of this technology on chocolate bars receives low attention from the consumer "The only real example where blockchain technology is used for traceability to the final consumer, but there is no real use for it...". There's a company from Olan, Tony's Chocolonely, who have all the chain traced in blockchain from the various countries from which they supply, to communicate to their consumers this traceability because Tony's Chocolonely was born as a brand against exploitation"---" but there is a problem and this I can tell you with certainty because I deal weekly with those who deal with this, the final consumer does not open the code is very rare, because it is not something that is interested.

- The interviewee says that when the quality of the product is above a certain level, there is no point in tracking the information because the quality is

intrinsic in the product itself and the consumer does not go looking for this kind of information. "Also, in this industry, tracking all the processes that give quality to the chocolate doesn't make sense, because the value is already intrinsic in the final product. It's like going to see the production process of a bottle of Sassicaia (a bottle of very high-end wine, with a price tag of 500 euros, ed.) The consumer is not interested, because the properties of the product speak for themselves."

B2B

- The advantage of implementing a blockchain technology on a very long supply chain such as the cocoa one is to verify the non-conformity, a contamination or a characteristic of the product that can hinder the production process. "First of all we have to make a premise: the cocoa supply chain is a very long supply chain because the cocoa is collected, has to be fermented, has a drying time, can run for 5 years, and the cocoa bean is used for different industries and has many other steps. Traceability, on the other hand, is of interest to the industry because most of the raw material that is processed is a raw material that comes from West Africa, some arrives in raw material and some arrives in semi-finished products that have already been processed ... the industry needs this type of traceability when you have a non-conformity, a contamination, you need to understand the parameters, not only as traceability of the product, but also as a quality control and compliance (e.g. has the cold chain been respected?).

- In this case having a blockchain reduces time, cost and better management o f the information : " for the availability of information, because in a long supply chain such as that of chocolate where the raw material has an average stockpile

of 5 years with many intermediate steps ... if there was no blockchain this type of traceability takes many people, it is a traceability for many stages related to paper in a cumbersome process ..." having a traceability with the characteristics of the blockchain, which surely you know, covering from 'origin to the final stage allows you to homogenize all these steps and speed them ... In addition, I also have an advantage of costs, because if I have to register my product on a third party system, because in some way must be notarized, having a blockchain system forces me first of all to homogenize a system that all others use, but above all amortize costs, because there are so many documents that I have to receive and at each step of the chain is recomposed this picture (in the 'example of an organic product that must be certified), while being all interfaced in blockchain has it' s automatic ... so this optimizes time and costs

- If they have large volumes, Producers are willing to pay such costs since savings are greater and there is a better management of information “ ... this is giving excellent results ... although this is a cost (derived from factory as RFID sensors, payment recordings in blockchain ed) that cooperative that produce extensively (which make the important volumes) is a cost that is happy to pay, as it brings the benefits we talked about before when then recovers in the intermediate management and administration in the various steps for example I will have fewer hours worked by the quality manager “

6.1.9. MZBG

Massimo Zanetti Beverage Group is one of the world's leading companies in the production, processing, and distribution of roasted coffee, founded by Massimo Zanetti. The Group has a portfolio of over 40 international brands, including Segafredo Zanetti. It is mainly involved in the production and marketing of roasted coffee and manages around 400 franchised shops. Italy accounts for around 8% of its turnover, which stands at around EUR 1 billion. The Group manages the various activities, from procurement to consumption, operating with 20 plants in Europe, Asia and the Americas and through an international network of around 400 coffee shops in 50 countries. The company has implemented blockchain to emphasize customer relations, "we have done this to strengthen the relationship of trust with our consumers around the world: by implementing systems capable of monitoring each stage of the value chain, we ensure full traceability and transparency."

The product on which the blockchain was applied is a high-end product whose traceability on the processes allows to enhance the quality characteristics and the storytelling of the product itself and the values of the brand " Segafredo Storia involved 51 farmers from the areas of Honduras. The Group's collaboration with local farmers is based on long-term development and cooperation in support of quality and sustainability". Precisely in Honduras, the Group has been promoting social initiatives in support of children's welfare and education for many years." Furthermore, the implementation for the company was quite simple as the company already had all the data and traceability infrastructure in place to enable the implementation of the blockchain, which simplified the process and kept costs down. "Implementing the blockchain for us was quite simple as we already have the data at home and therefore if I need to know certain information, I can easily find it. This for other companies is not possible or would come with higher costs". Moreover, the interviewee says that there was no reason of undertake such project for efficiency reasons "we already had all the data at home, so the only motive that pushed us to do it was to guarantee transparency from the plantation to the cup for the consumer".

Regarding consumers, the company has chosen not to introduce the word "blockchain" in the packaging because of their market research seems to have a negative connotation: "we have market research that tells us that a public over 35 associates the word blockchain with a penalizing meaning for us ... now, without going into detail, but we have chosen to write in the packaging only transparent and traceable. According to the interviewee, the real impact has been at the level of the brand and corporate reputation. This project has been a factor of differentiation of the company, as it has brought an innovative product in the round: "the impact on the brand has been enormous, as we are the first in the world of coffee to bring a fully traced product and this at the reputational level has affected both the business and the consumer...". In fact, the media return that this project has generated has been considerable: "we have received numerous newspaper advertisements and several requests for interviews, and special attention from all our stakeholders." The strongest impact has been on the trade, as this product has allowed them to expand their B2B opportunities, specifically with retailers. “Blockchain has a great impact on our reseller. The fact that we introduced this trackability systems gave us more shelf space in the resellers, even if we did not invest a euro in it. It was unexpected. They are looking for innovative product, to product that the customer wants, in this sense, our product (in the coffee industry ed) was the only one that could tell a different story on the shelf”.

Still remaining in the B2B area, the project was of great interest to the direct stakeholders of the company, who asked the group to be able to become part of the blockchain itself. This produces a double value, as it allows the focus company to have further certification on the origin of the packaging materials, on the other hand to the supplier to be able to certify their origin. “The thing that surprised us is that after implementing this system, we have had important feedback from the business world, which opens up new frontiers. For example, our packaging supplier has requested to be included in the blockchain, to certify the origin of its materials. " This also allows the focus company to automatically align their suppliers and their stakeholders who want to participate in the blockchain to the company's standards. "You understand that

this is a great advantage because you who are the promoter of a new technology create a system where others want to align themselves with your values, at your level of transparency and of quality ". This is possible as the technology implemented by MZBG is a private blockchain. The company also has an interest in expanding this project, adding new products and new information, thus improving communication with a customer. "In the future we plan to expand the origins (of coffee), insert new suppliers, or insert the issue of emissions, for example by monitoring the discourse of green premiums" ... "the blockchain project is a project without compromise, which is why the processing of coffee is made in Finland, which is our most sustainable plant "

6.1.10. ROUGE

The Consorzio di tutela dell'Arancia Rossa di Sicilia IGP together with the technology partner Almaviva launched the project Rouge - Red Orange Upgrading Green Economy, which from the 2019/2020 harvest offers smart traceability solutions thanks to an ad hoc digital platform based on Blockchain technology. This project is not only an application of blockchain technology created open hybrid platform. "Hybrid because it uses both the data of individuals, the companies in the consortium, as well as public data made available by Sin-Agea" open because "it can always be supplemented by new players who can get on board whenever they want". It also uses an app that allows consumers to monitor the production field thanks to a system of geolocation of the map provided by a public source, as well as the date of harvest and the methods of preservation and distribution, knowing the entire history of every single package of Arancia Rossa di Sicilia Igp through their smartphone.

For the consortium, the reason they implemented blockchain for traceability was linked to the value of the ecosystem and brand protection, offering a service to members that would allow them to go beyond the normal quality controls of the mere IGP , which seemed no longer to be enough in front of consumers and business partners

" We wanted to provide services to our members, because as a protection consortium we always find that being registered with a IGP does not give that added value to the product of being subject to a quality consortium to the producer, i.e. the trader who comes does not pay those extra cents that a quality chain could have...". "and this could also be linked to the decreasing attraction that the consumer has". Another key issue was to protect against counterfeiting and fraud "So we have set ourselves the objective of helping producers by offering them services and working against counterfeiting and fraud, particularly on traceability. " In addition, among the advantages for the producer is that of getting in touch directly with the consumer and creating a point of contact that the consumer didn't have before, putting them online via an app, also giving them the possibility of being able to insert all the descriptions they want within the app, thus creating a communication service for the producer “"We give our producer the opportunity to make himself known and to get in touch directly with the consumer, putting them online through an app, also giving the possibility of being able to insert all the descriptions he wishes within the app, thus creating a service of communication for the manufacturer.”

The advantages for the consortium are twofold: On the one hand, they are able to enhance the brand as the blockchain plays a differentiating value compared to other consortia and this makes the number of registrations go up as producers have more interest in joining "On the other hand, we are also the first to make it possible to ensure visibility for the consortium… an aspect that is underestimated by others." On the other hand, it allows us to talk about the efficiency of operations, as it makes data available in real time to carry out analyses in order to protect the brand. "We can have instant access to data and carry out analyses on sales data in order to know who has sold, to which distribution and to which country"

As for the B2B level, having traceability certified in blockchain, large retailers have welcomed blockchain as it simplifies the management of paperwork and access to data, “In the large-scale retail sector, however, there was already traceability because it

requires all the documentation, but if this documentation becomes virtual and editable, it is much better for them because they have faster access to data and simplifies the bureaucratic processes of requesting information….all the more so in a chain as long as the orange chain."

Blockchain also helped the company with exportation Chinese consumer has rewarded this choice, thus also the exporter has taken advantage of that: "blockchain has also benefited exports because the level of counterfeiting is high and has helped consumers to make a safer and more informed choice. He (the consumers) tracks the producer, and he is sure, it gives him security. "It was implemented for the Chinese who were satisfied with it (for exports to China and so on) …we had all made it for the Chinese exporter who brought there as an innovation to China and consumers, as I told you, appreciated it"

In addition, again with regard to the export key, blockchain traceability simplifies bureaucratic processes "The platform also guarantees the product and, in this way, lays the foundations for important bureaucratic simplifications in the export key". As for the consumer plan, this project has had a strong impact on e-commerce, as it has certainly helped to boost sales, so much so that some manufacturers have even written "certified with blockchain" on the box. "It has increased a lot; I do not remember precisely but certainly more than 10% of the total volume due to the pandemic. But from the data we have we have noticed that those who have leveraged blockchain traceability have produced (and therefore sold ed) more".

Future possibilities

The project has just started, and the company would like to expand the possibilities it offers, creating a true ecosystem economy where all the actors that interact with the consortium are on blockchain. Both downstream players "we think that the players to whom we think the system could be extended are mainly those downstream of the chain such as distributors and foreign importers." but also upstream "For example,

packaging: include all those who do packaging. In fact, those who make packaging will say that they make unique packaging for the blood orange," who will be able to certify their packaging using blockchain technology and have valuable data at their disposal. because they do the deliveries, and they can also have forecasts and benefit from the statistical data". This also provides an advantage for the consortium, which mainly performs a control function: “Because the role of the consortium is to control, in fact we have control systems that actually check who the producers are and what they have produced'... 'each one of them (the packers, ed.) will say how many packages they have done; consequently I know how many oranges have been produced and so I calculate how many packages they can fit in. If there is more packaging, it means that someone has produced more oranges that have not been under our control” Furthermore, a further possibility would be to be able to implement immediate intervention solutions directly on the consumer, with chatbots for example. This greatly reduces the distance between the brand and the consumer, creating a direct communication channel. "What was important on our part was to create a solution that would not only give value as a media impact, but that was modular and functional to make the ecosystem grow" (Almaviva) ... "for example, an implementation that we are thinking about to do is that of a chatbot that allows us to collect data directly from the consumer, on product quality and deterioration "(Almaviva)

6.1.11. BASF

Risochiaro is a pilot project launched by BASF and Azienda Agricola Coppo e Garrone. BASF in one of the biggest chemical company in the world, with more that 70B turnover, while Coppo and Garrione Soc. Agr. S.S. is an Italian excellence in the production of quality rice, with over 1,000 hectares managed by the Coppo-Garrione family of entrepreneurs at Tenuta Darola. Despite its the unripe nature of this project, since the biggest impact can be evaluated only at the end of march, the project has been presented since it has interesting implication on the business model and on how a blockchain can create value in an ecosystem. "We are still in the first year, and we haven't really been able to understand how much impact this type of technology has on the volume of sales"

BASF is a company that has launched the first example of blockchain technology applied to the rice supply chain. The initiative stems from BASF's desire to help protect and promote Italian rice farming, a true excellence in terms of both quality and quantity. The platform offered applies blockchain technology to record, at every stage, all the data of rice cultivation, storing them in a secure and unalterable way, allowing the collection and transfer of information about the cultivation of rice, such as: data related to the geographical area of production, the varieties planted, the extensions, irrigation programs, fertilization, and crop protection, tracking the different stages of growth of the grain. Each stage of the process will therefore be tracked, entered in the system, and stored in a single shared register, the RISOCHIARO blockchain. As well as increasing the transparency of the production processes, RISOCHIARO certifies the crucial stages of growing and processing the cereal.

The project was born in the exploratory project of digital as an opportunity which the company is analyzing under all the different aspects and potentials (e.g., with the introduction smart contracts). This project is extremely interesting for BASF, since it acts has a platform provider, sitting on the top of a technology, blockchain, in a market that can be shaped as a two-sided market. On the one side there is the rice producer:

thanks to the EPR and RFID systems supplied by BASF, the rice producer is able to collect all the information on the various rice growing processes and the blockchain is able to transfer it directly to the rice mills, which are also registered in the blockchain. According to the interviewee rice mills are willing to pay a price premium for rice that can certify all the quality steps and standards. The advantage of the blockchain resides on the fact that it "dramatically improves the regulation of the contractual part because the rice mill can immediately trace all the information on the rice it needs, saving hours and hours of work".

On the other side there is the rice mill, that first has interest in having all the information that ensure conformity to the rice, and second blockchain permits to transfer all this information throughout the supply chain, to the end consumer. This can provide several benefits, both for the B2B and the B2C markets, of which we have spoken in the previous cases, and which are summarized in the following chapters. Moreover, BASF is intent on creating a sort of a digital identity of RISOCHIARO, what could be assimilated to a DOP trademark for all the company that participate in the project. For the Producers it gives more visibility to the farms that are part of this project while for the rice mills can use this sort of certificate on both online and offline. Moreover, the use of the QR code has a data intelligence function for companies because when the consumer scans the QR code it gives you access to a whole series of data that are important for marketing purposes, for example to carry out a sentiment analysis on social media, giving a farm some insight into what the meta tags on google and more.

6.2. Cross Case Analysis

6.2.1. Reasons to implement a blockchain

	Enhance customer relationship	*Differentiation*	*Overcome traceability standards*	*Operations efficiency*	*Create a unique BM*	*Unique possibility to meet certain trac. levels*	*Proof product quality or peculiarities*
Foodchain	SME	SME	SME	MNC			SME
Bofrost							
Pietro Coricelli							
Pralina							
Chocofair							
Mancini							
Latteria Sociale Val.							
Trufflemarket							
MZBG							
Rouge							
BASF							

Table 8: Reasons to implement a blockchain

Almost all the company primary objective when they choose to implement a blockchain was to enhance the relationships with the customers. It was mainly a communication issue, since they want to achieve a direct contact with the customer towards the product, having a place in which they could show transparency on the work they did. This is not surprisingly: most of these products are niche products and excellences, with a high positioning compared to the market standard. Thus, companies have interest in showing what are peculiarities, that can be production process, ingredients, analysis, or origins that confer this superior value to the product. This becomes a new communication touchpoint for the customer, who by scanning the QR code can access the whole features. This, according to the interviewer, helps him in performing a better choice, since awareness on the product increases. Moreover, it was a way also to differentiate from competitors: blockchain is a novel technology, scarcely adopted, and by doing so they want to add a new feature to the product that competitors do not have. Being niches products, they are chosen by customer who makes a conscious choice, so which have interest in knowing how the product is made and what it contains, and that effort was done in other to abandon traditional information on the packaging and creating a new digital experience on which he could verify all the information in a trusted environment, the one on blockchain. Peculiar cases are the one of Mancini, Pralina and MZBG. For the first company, the main communication issue was to show this particular way of doing pasta, which is very unique in this sector since the company produce the wheat and does the pasta with the same wheat it produces, in a process that can be compared to the one of wine. While for Pralina and MZBG the communication point was to enhance the peculiar origins of the raw material of the product: Pralina made a product with local legumes and grains relating to the biodiversity of the area, grown by cooperatives of young farmers who have returned to cultivate land abandoned for some time, through natural, sometimes non-certified organic farming. While a Segafredo Storia is a 100% mono-origins café made in Honduras, where the company has undertaken some social activity. In these three use cases, implementing a full transparency on the product and

giving the possibility to access it with QR code was an enabler to access the storytelling of the products.

Regarding the choice is the blockchain technology, according to most of participants it was the only technology enabler which was able to guarantee the satisfactory level of information they want to deliver up to the customer and that was the main reason for which it was chosen. Moreover, companies cannot declare what they want in the blockchain, since information must be verified and trusted. Even if according to many participants consumer readiness towards the technology is not so high, they agree on the fact that it is increasing, especially among millennials and young categories.

6.2.2. Impact on the customer

Benefit towards customers			
	Increase trust in the product	*Customer loyalty*	*Acquire new customers*
Foodchain			
Bofrost			
Pietro Coricelli			
Pralina			
Chocofair			
Mancini			
Latteria Sociale Val.			
Trufflemarket			
MZBG			
Rouge			
BASF			

Table 9: Impact on customers

Primary objective for food companies is to enhance the customer relationship by providing a transparent view on the supply chain though blockchain technology (9/11).

Hoverer, most of the implementation of these blockchain projects are novel and companies do not have enough data in order to understand the impact of the introduction of blockchain. On the other hand, there are some companies that has a positive response from customers. Here below, for each of them is going to be presented what according to the interviewed people led to this result:

- Bofrost: First, Bofrost has a massive publication among specialized and non-specialized newspapers (“more than 100 publication) and this create a huge attention on the company and on the project. The explanation on the newspaper where able to clarify which were the capabilities of the technology (secure, tamper proof, immutable and transparent ed) and this increased the company reputation (towards security) for the customer. Moreover, company has salesman which are in strict contact with the customer, and they are able to communicate directly to the customers that Bofrost has implemented a full transparent chain for those two products. According to the interviewee, this safety hazard has an “umbrella effect” on all the products. Despite so, the product did not receive enough attention since number of QR code scans were low.

- Mancini: Mancini success factors was determined by the fact that their products are positioned as high-end products and their customer are conscious about their choices. Indeed, they are interested in knowing more about the processes that give the pasta a superior value, since it the distinctive characteristic of Mancini’s production process.

- Latteria sociale Valtellina has done an in dept analysis on the customers and data were shown in the relative section. From the evidence there were two predominant factors: Blockchain was the reason that increase the degree of confidence in the label from consumers, since 80% of the respondents says that they will have higher degree of confidence is product was tracked by blockchain, while the web app was useful for more almost 55% of the respondents to increase the trust on the quality of the product.

- Truffemarket: Increased trust in the product and increase in the customer base was given by the fact that the company implemented a blockchain and as a mean to certify the provenance and the respondent has no doubt on that, also because there

was a difference between pre and post adoption. Moreover, truffles are a product on which knowing the provenance is determinant to know its superior quality.

- ROUGE: in this case study there was weak evidence that blockchain has increased the trust towards the products since e-commerce that showed traceability with blockchain has sold more compared to those without blockchain and some producer has written “traced with blockchain” in the box

For sake of completeness here is presented a sentence from Chocofair founder affirming that “Italian are interested to know more about traceability of products for products that are part of their culinary tradition”. This information seems to be sustained by the empirical evidence: all the product that received major attention from the customer are products that belong to the Italian tradition: pasta, truffles, red oranges, and milk. On the other hand, cod, artichokes, and chocolate are not typical Italians and this may justify the low QR code scan rate. As data become available, it would be interesting to know more about coffee from MZBG and oil from Pietro Coricelli, which are two typical Italian sounding products.

Given this consideration, four main variables can be identified which could impact on the trust towards products

- Knowledge of blockchain technology
- typology of product
- familiarity of the customer towards that product
- familiarity of the customer towards the production process.

6.2.3. Impact on B2B

Impact on B2B					
	Open new business line	*Increase redditivity*	*Enforce B2B relationships*	*Impact on resellers*	*Impact for export*
Foodchain					
Bofrost					
Pietro Coricelli					
Pralina					
Chocofair					
Mancini					
Latteria Sociale Val.					
Trufflemarket					
MZBG					
Rouge					
Basf					

Table 10: Impact on B2B

6.2.4. Impact on resellers

Starting from the most evident one 7/11 company who implementing blockchain experience an impact on the resellers. Indeed, Having the possibility two show data information and quality control on the product is appreciated for the reseller. The reason could be different: one could be associated to the fact that they are looking for innovative product and interesting from the customers. According to many participants (Pralina, Mancini, Latteria Sociale, MZBG, foodchain) the resellers knows that customer request on food traceability is increasing, and this is also proven by data (IBM Morning Consult European Food Responsibility Study). For this reason, retailer evaluate positively having such traceability systems and firms benefited from that (e.g., more shelf space (MZBG), new retailers acquired (MANCINI).

Another major issue is that implementing a blockchain for the traceability can give an indelible proof of all the processes that a product passes and in some case, they are determinant for the value of the product. For example, to declare baby food you need to have certain parameter or in a fresh or frozen product it is essential that it respects the whole cold chain. Having a blockchain on the production process can let the business partner to have access instantly to that information which can be guaranteed by the technology itself. Carrefour implemented a blockchain for the traceability of private labels products and business partner are obliged to have traceability system with blockchain, otherwise are cut off. Moreover, for Carrefour having a blockchain for traceability partially impacts on the choice of a supplier “We do not require blockchain traceability for all our supplier, but there are some products for which it is required (e.g. chicken ed) If we ask for it, it is essential that the supplier has it, otherwise the firm cannot be our supplier.” …” (talking about different products) Of curse if a supplier can also show traceability their product through blockchain is a plus and is appreciated” … “ now it is not, but if technology takes hold, I don't rule out that it could become indispensable”(Angelo Arrigoni, Head of Quality Supply Chain and Blockchain Product Owner at Carrefour Italy) But this is not the only case: The

largest retail company in the world, Walmart, technology. Walmart in 2017 has started a sperimentation together with IBM for the traceability of mangos and pork meat and on the 17 may 2020 has sent a letter to all its suppliers of farmed goods urging them to track their produce using blockchain technology (SupplyDigitalchain 2020). According to two of the interviewers this is not surprisingly: “in the private sector for suppliers will be required this type of technology to try and prove this type of information in their supply chain... While in the first case (P.A ed) it will still take some time, the latter (GDO) is much more frequent also about large-scale distribution. The trend is to increasingly abandon what are paper documents to approach what is a higher level of security. Although the regulatory framework (law) is not yet ready, the push is coming from the bottom as companies have requests and the technology that has been identified as the most suitable is precisely the blockchain… there will be alignment to a level of standards that are not European, not national but are global” (Foodchain). “(customer knowledge of blockchain “It is growing because the concept is starting to develop, it is being watched by large multinationals in the agri-food sector, there is someone who is already applying it”. To conclude, there are some cases in which the business partners are willing to pay more for products that can show the entire traceability of the supply chain

6.2.5. Enforcing B2B relationships

In this case alignment is a key variable. Among a supply chain there are often different actors, for example producer transformers, packers and so on. Implementing a blockchain towards the supply chain force all the participants of the network to align to the standards of the focal firm. The focal firm is the one that implement the blockchain at first (e.g. Bofrost or Mancini) and which impose the standards requirement needed. Despite it could be a cost for the other business actor, it brings advantages from both side: the focal firm is able to closer monitor its business partner since it has the complete information on what the other partner is doing. The partner

take advantage from the fact that once this system is implemented, the focal firm has less incentive to change supplier for different reason: focal firm will lose the monitoring and should convince another business actor to implement such technology. Changing supplier is not easy and become even harder in a condition where the new supplier should sustain a cost to implement a blockchain system. An example is brought by the Bofrost case: bofrost initial SKU were not the actual ones, but it was extremely hard for them to find the right partner to undertake such project, since its suppliers don't want to undertake implementing cost. Thus, the company was able to implement the project on the two refence where suppliers where willing to sustain that cost. By the end they established a concept of partnership and Bofrost is not changing the suppliers for those two products. Bofrost has committed to the customer a complete transparency and it cannot deny such promise.

6.2.6. Increase redditivity

For some categories of products having a blockchain that can guarantee the origin and the quality process that a product had submitted can guarantee a premium price for the business actor. Regarding the quality process this is the case for example of Risochiaro, since rising mills recognize a premium price to see all the quality standard for the rice or of ROUGE, where in the interview is said that buyers where no longer recognizing a premium price for the IGP stamp, while having a full transparency that could be proven, also up to the final customer can led the intermediary to pay a premium price. Regarding origins, there are products on which the value is heavily affected by the provenance of the products (e.g. truffles, Pistacchio di Bronte, Arancia IGP) and there are numerous fake agents which tries to counterfeit the product. Sometimes there are protection consortia as the Arancia Rossa IGP, which role is to control the inbound and outbound flow of the product, to detect If there are inconsistencies. By the way, consortium is not infallible and numerous frauds are committed every year. For example, taking into consideration Arancia Rossa 17.7%

of declared IGP oranges are irregular. For this reason, buyer recognize a premium price for guaranteeing the provenance.

6.2.7. Impact for export

Even if it is not a standard, there is an increasing trend in paying more and more attention to blockchain traceability, especially for those products that are "made in Italy". This because a product to be declared "made in Italy", according to Italian law, it must have the latest transformation made in Italy. So, a tomato that come from Norway transformed in Italy and then sent to US can be considered made in Italy. For this reason, international buyers are paying more and more attention to the provenance of the product and being able to proof with blockchain the whole traceability of product is rewarded by e the international partner. This was also found by Rouge, Pralina, Foodchain and Trufflemarket

6.2.8. Open new business opportunities

In this case the three examples are isolated one by another, but it is still valuable to present them. The first is the case of a of a rice mill, tracing a particular method to produce rice managed to enter the baby food market, managing to demonstrate that the selenium level was below a standard level. The second one is Gelateria Marchetti, which partnered with Caffe San Domenico to create the first tracked ice cream and the third was Pralina which created two new business opportunities: the first was that were invited to participate in the Florence tourism exchange precisely for the application of the Blockchain and how this can connect to the story of the territories being aspects, the tourist and the agri-food one, that can interact with each other. The second was the implementation of the technologies to open to private label the opportunity to certify their production.

6.3. Impact on company brand and ecosystem

	Impact on the perceived image	*Visibility*	*Positive ROI (accomplished)*	*Positive ROI (expected)*	*Operation efficiency*	*Enhance the value of the whole ecosystem*
Foodchain	Sells solutions					
Bofrost						
Pietro Coricelli						
Pralina						
Chocofair	Consultant company					
Mancini						
Latteria Sociale Val.			Public financing			
Trufflemarket						
MZBG						
Rouge						
BASF						

Table 11: Impact on company brand and ecosystem

6.3.1. Impact on perceived image

Even if there were no direct measures on that all the companies interviewed has gained an incredible impact towards the brand under different terms among both business and consumers. Implementing a blockchain to trace all the supply chain was rewarded under four major aspects: company positioning, reputation, credibility, and security.

- Positioning, since all the companies did traceability on a product which was strongly correlated with his values and mission, thus offering a complete transparency on their processes helped to strengthen their position.

- Security, since consumers now has the possibility to verify all the information, thus according to the company, they feel more confident and reassured in the purchase knowing that the company discloses all the information on the product, including all the safety analysis of the product.

- Reputation, since the attention that was given to this project was remarkable and companies got many positive feedbacks also from the business world.

- Credibility, since a company that offers a level of traceability which is most of the cases exceeds the regulation is an indicator that there is no interest in hindering the information.

6.3.2. Visibility

In all the cases the media attention towards that project was extremely high. First because blockchain is a novel technology and those were among the very first applications. Secondly, because most of the companies operated in traditional end static sector, where technological innovation where mainly linked to improvement in

the production processes. Moreover, some of them (e.g. trufflemarket and Pralina) received mention of merit from the government. On the other hand, here company adopted a disruptive technology for their customers, with the aim of open the company's door to their way of working.

6.3.3. ROI

One of the major issues of undertaking such project, as in all the projects, is linked to return of investments. As stated, several times in this discussion, implementing a blockchain comes with costs and this could prevent firms to implement to adopt it. Before going on, it is necessary to point out that different solutions come with different cost, also according to the technological readiness of the company and the integration with EPR systems. Despite so, all the companies that early adopted those solution said that the return of the investment was positive, while the others stated that are sure is going to be repaid or it was partially repaid. Even if in some cases, the return was not strictly linked to commercial issue, this time companies in evaluating the return on their investment has adopted a broader perspective. As stated in this work, implementing a blockchain for traceability has not only an economical value of the number of product sold, but impact also on many other soft factor, as company credibility.

6.3.4. Operations efficiency

This aspect was evidence mainly in companies where the solution was designed for these purposes. It come more often in long and complex supply chains, which involves different actors and an important volume of information. Indeed, having all the information available in blockchain reduce the time and the cost of managing,

retrieving, and sharing that information. Even if there were just few documented real use cases, this aspect was widely discussed in the academic literature.

6.3.5. Enhance the value of all the ecosystems

Blockchain is a distributed ledger technology, and it is conceived by design to offers significant benefit to all the actors involved. This is particularly emphasized when blockchain is used as a platform: ROUGE, Risochiaro and Trufllemarket are three examples where the firm, which in this case are the platform provider, created a favourable environment where participants of each side have interest in joining the network.

Chapter 7 - Final interpretations

7.1. Theoretical point of view

As pointed out in chapter 3, the research was focused to understand the benefit of implementing a blockchain in the traceability systems. In chapter 4 it was performed a within and cross case analysis to understand which were the common factors that brought companies to implement the blockchain technology for traceability and the relative benefit coming with it. The literature in the agri-food blockchain focuses mainly on the technical aspect to provide solution among complex and long supply chains, which involve a multiplicity of actors (Feng. 2016, Feng 2018, Credyt et al 2019, Galvez et. Al 2018, Jie Ju et al 2020). The main benefits coming from all these authors were: Data traceability, food Safety and quality monitoring, preventing frauds, deliver real time information to all supply chain members, and efficiencies on time and cost. Different technical aspects were investigated as the best practices to implement blockchain and the other technologies used (e.g., RFID). Empirical evidences confirms theories of scholars, since in the three case in which it was applied, namely Chocofair, Rouge and Carrefour, the practitioners confirmed that having a traceability systems to monitor the supply chain “is giving excellent results"(Chocofair) on the forementioned parameters. In the case of Chocofair the actors of the chain are willing to pay a subscription cost of blockchain to have an instant traceability of data in order to detect instantly (real time information) product nonconformity (quality monitoring). In this

industrial production process this is crucial since the non-conformity can cause serious production problems. Without blockchain this process is slower and costly because many actors are involved (in collecting and delivering those data). On the other hand, the case of ROUGE underlines the importance of having real time access data, since having the full control over the traceability the consortium was able to detects frauds, verify the quality conformity, and reduced the time and the cost of monitoring.

On the other hand, scholars suggests that the marketing, social and economic sciences' researchers should devote efforts to the application of BC and its impact to consumer trust because this aspect is receiving very few attention among scholars (C.F Da Silva 2021).

This work intended to address such concerns to point the main variables that can influence consumer trust towards the product, namely:

- Knowledge of blockchain technology
- Typology of product
- Familiarity of the customer on the product
- Familiarity of the customer on the production process

Customer knowledge on blockchain technology admits customers to understands the blockchain capabilities. As it was presented in the literature review, according to the framework of Montecchi et al 2019, blockchain capabilities deliver assurances to the customer by providing traceability, certifiability, trackability, and verifiability of product information along the supply chain. Different scholars pointed out how these assurances can impact purchase intention:

- Hall et. Al. 2015, Laufer et. al 2018, Lee 1993, affirms that providing origins assurances can impact customer product evaluation and in turn purchase intention

- Beverland et al affirms 2010 Authenticity assurance is critical in many purchasing contexts because customers tend to pay greater attention to product cues that communicate authenticity

- Clark et. al 1190 affirms that a product with integrity meets customers' expected levels of quality and reliability, delivers superior value, and ultimately represents a critical source of competitive advantage for the firm

- Montecchi et al 2019 Customers' confidence in the purchase is reinforced by having information on the chain of custody and its management, including transportation and storage conditions and methods.

There assurances can reduce customer perceived risk, namely: financial Risk, psychological risk , social Risk and physical risk. Here it comes our second variable: typology of product. Different products have different risk connected to them:

- Caviar is linked with financial risks, since their price is dramatically high

- Fish and meat are linked with psychological risk since customers might want reassurance that they are not behaving unethically by contributing to the business of not responsible fishing or intensive animal husbandry. Customers also want to avoid the potential social risk linked to other people knowing that, willingly or unwillingly, they have purchased such products

- Truffle is linked with performance risk, since the quality of the product is determinant to its taste

- Dairy products are linked with customers physical risk, since wrong storage of the product could harm consumer health.

Moreover, empirical evidence of this research underlines that customer's familiarity of the product could play a determinant variable. Even if there are many researchers pointing out that customers want to know more about the traceability of products (IBM

Consult European Food Responsibility Study, Feng Tian 2018, Juan F. Galvez 2018, Kang and Hustvedt, 2014) none was addressing the fact that familiarity with the product could impact customer's interest in knowing more information about it (e.g. ingredient provenance). This is linked to what the literature acknowledges as status quo bias (Samuelson et al 1988).

Similar consideration could be done on familiarity in the production processes: if production processes are complex or unknown, trying to understand them would cause a status on anxiety (Nakamura et. al 2009), thus preventing the customer to benefit from such information. (Questa cosa non so se è 100% corretta).

7.2. Managerial point of view

Mougayar 2016 points out that Blockchain technology is in its early stages, there are limited number of supply chains that successfully implemented this technology to track their products and the lack of business models and best practices in implementing blockchain technology is a challenge .This work propose a comprehensive framework in the agri-food systems, pointing out real uses cases that successfully implemented this technology with related advantages at the consumer, business and company level. Data shows that customer are willing to know more about the product they consume and implementing a blockchain technology is considered by the interviewees the best and the only enabling technology that allows to have a satisfactory level of detail to satisfy customer requirements. This opportunity seems particularly attractive for SMEs which has niche products with superior quality and production processes, since blockchain can give and immutable and intangible proof of the practices that confers those attributes. Moreover, it enables companies to communicate to the customer its values, mission and commitment among consumers and society. Interesting is the use case of Pralina, where the blockchain project was done to enforce brand mission in the commitment towards local people and territories or the one of Pasta Mancini, which

wanted to underline is peculiar way of producing pasta, which the main reason that pushes customer to choose the brand. Another remarkable was the one of MZBG, which tracked a monorigin coffee from Honduras, where the company has social and environmental activities open.

Moreover, it can play a differentiation level both on MNC and on direct competitors: in the first case, MNC are often not able or not willing to adopt a full transparency on the supply chain since their product quality are bundled to industrialization and high volumes. On the other hand, adoption of this technology is still scarce and firms adopting it may benefit from first mover advantage. In fact, implementing a blockchain for traceability processes leads to both short term and long terms advantages. While the existing benefit has pointed out in the result chapter here there are going presented which could be long term advantages. First, they are linked to the fact that is a vivid project and opens up different possibilities: for example, companies which start tracking the products could also let their supplier (e.g. for packaging) entering the blockchain in order to enhance the transparency and the sustainability issues on the whole product. Another important factor that could be disrupting on the business is the collection of data in a double perspective. Implementing a blockchain together with ERP systems can improve the control on the production processes and a better-quality monitoring. Despite so, many of the company interviewed has already the infrastructure that enables them to track all the data, and even this facilitates the implementation (costs are lower) under the forementioned view no further data can be gained. Here come the second issue: by scanning a QR code the customer enters in the company website and can check all the information on the product in a trusted environment. As said, this improve the experience and the perception of quality of the product but pays another key role regarding data, which was pointed out only by one interviewer (Risochiaro). If the users accept the privacy conditions, the company is able to perform data intelligence analysis on the customer who enters the website, namely social media sentiment analysis, geotag, average session time, most visited pages an so on. Since almost all projects were conceived for a communication purpose,

having such data for marketing departments is crucial, both for targeting and digital asset optimization (as website). The surprising thing is that comes with almost no cost, since the is no effort for the company in let the user scan the QR code. Indeed, bringing user on company's website though advertisements on google or social media is a burdensome activity. If the company could exploit those data, the impact could be tremendous.

To conclude it must be said that all the companies interviewed has declared that the return on the investment was positive or that were sure that will be repaid in the future. Even if maybe, it is difficult to exactly monitor the commercial outcomes, all the companies perceived positing impact on the brand among credibility, security and reputation, and this let the companies to better position in the mind of the customer and towards business partners.

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Appendix

Here there are all the trascriptions of the interviews.

Bofrost

1) What reasons do you implement blockchain for process traceability? (efficiency of operations vs. consumer relationship). If both: which one weighed more in your choice

Certainly for us it was the communication towards the customer, probably at the level of operations for us it was not necessary, it was necessary more a matter of visibility and transparency by the company to its consumers, all that is our process, the fact that our products are excellence and for us it was therefore a way to communicate quality and added value to customers.

2) What are the main advantages for consumers of blockchain compared to a traditional traceability system?

In this case there is no choice, in the sense that in the frozen food market I do not find any player who goes for a product to put what is the temperature, when it arrived, when it was fished, when it arrived at the headquarters when it was shipped and there is no one who publishes all the analysis that are done on products. For bofrost this is a factor of differentiation and competitive advantage over its competitors.

Have you evaluated other alternatives to certify the origin? If yes, why did you choose blockchain?

The only one that met the requirements of total transparency towards the customer was the blockchain, so we adopted it.

3) Does blockchain impact the level of trust between you and your consumers? If yes, how?

We don't have a precise measurement, but being a company that is in close contact with customers as our operators weekly contact us and receive our operators at home for the delivery of goods, I can talk about the qualitative considerations that come through the customer service and from our sellers that well or badly entering into the home of customers bring us what are the considerations, which were extremely positive.

First of all it is a source of pride for the seller (B2B) that bofrost is so transparent, but also through the customer. It was not something that made us sell more, nor could we have a price premium on the two certified products, it is something that was more of an umbrella effect, as the perception of security was not limited to only 2 certified products but also brought a confirmation to non-certified products because in the mind of the consumer if they do on these products that are certified will be so all, or however that is their way of working and therefore had a positive effect on 'company that then turned into security on all products

4) Has blockchain changed the consumer's experience with your products? If yes, how?

It hasn't changed the consumer's experience because the scans have been few.

5) How has blockchain affected the perception of your brand/company? Have you had any feedback on this? Which aspects have been most impacted (brand/company image, credibility, relationships with suppliers)?

The return of image that this project has had has been absolutely positive, we have had a lot of press releases both in the more specialized press but also in the more popular press, so in terms of brand awareness and brand security has increased a lot. From memory we have had more than a hundred press releases and this has led to a very important effect on the brand. We have had an increase in customers certainly due to the pandemic, but I am quite convinced that they have turned their attention to bofrost also because they had an idea, a feedback and a positive perception of the brand and therefore they chose bofrost.

Was there a scan increase during the pandemic?

NO

Do you think the investment you made has paid off/will pay off? If yes, why?

The cost has been high, it has definitely been covered by what we were saying before in terms of press releases and brand awaeness. We would love to increase the number of blockchain certified references, however although we have had extremely positive feedback in terms of visibility but not direct sales on those two codes in particular. So we have to do it only for references that have critical mass, or on items that for their typicality need this storitelling and this security certification.

What do you think is needed for this technology to spread more from the bottom or more from the top?

The development of this technology, the greatest difficulty was to find the right partner, there is not a culture in the partners, that in these cases we buy already as a finished product (and packaged ed) and it is clear that when I go to ask to insert a sensor in the fishing boat or in the harvest of artichokes is a cost and for this we had great difficulty from that point of view. And this is a short-sighted view, because for example with our two suppliers we have established a relationship of greater trust and at this moment we are not changing, nor do we intend to, the suppliers. Because beyond the mere fact that it would be a cost, we have established a concept of partnership. As we of bofrost have invested in fidelity towards the final customers, the suppliers have invested towards bofrost, creating a virtuous system for both. There's an industrial substrate that doesn't have that blockchain culture like for example in the US, where that's a prerequisite where for example some mass retail companies like wallmart, like we now have a prc certification, wallmart requires a blockchain certification. At that point that becomes a standard. That's a major limitation.

Mancini

First, a brief introduction of what the Mancini company is and a contextualization of what the company is and what it does.

Mancini agricultural company is a different entity from Mancini pastificio agricolo, but both cannot survive without the other, in the sense that the agricultural company has existed since 1938 and was founded by Mariano Mancini, who is the grandfather of Mariano Mancini the current owner, while Mancini pastificio agricolo has existed since 2010, that is, since Massimo Mancini decided to add a further productive step to the cultivation and sale of cereals that was the business on which the agricultural company was founded before. With Mancini pastificio agricolo we add the step of transformation, that is, we close the circle from the sowing of the grain and the selection of the seed from the sowing to the cultivation, and then we produce pasta only with the grain that has been grown during the year and this applies to each agricultural year, so currently we have just completed the harvest of the year 2021 and we are already planning and preparing the land for the sowing that will take place in November of the new wheat with which we will make the new pasta. We are in the Marche region in Monte San Pietrangeli. It is a company that has existed since 2010 and now has 35 employees, I am in charge of communication and marketing.

NC: Regarding the Blockchain project that is being implemented, first of all, what were the reasons for implementing it? For the traceability of processes, so for a speech of efficiency of operations or for the relationship with the consumer. And if both, which one weighed more.

Implementing BC was a decision made by multiple departments here at the company first. So let's get to why we decided to put this extra service in. So., we received many, really many, applications and requests from companies that offered to be able to open this new channel, so start-ups, new developers... we were very impressed with the possibility of being able to develop this service for the consumer also combining it with the possibility of implementing tools that we had, because the digitization of the company was a goal achieved and in a year we brought forward this opportunity. We have combined it with the possibility of hooking up a traceable supply chain even if we are not talking about a real supply chain because we do everything ourselves, there are no other actors or external companies, thanks to Apio. It's a start-up from Pescara where there are also young people, some are still in school, and some are our employees, who proposed us the possibility to enclose in a call both the possibility to have new tools that would follow the digitalization in production and especially in packaging and at the same time to create a profile that would exploit BC technology. So it's something we've straddled, 50/50, both as improved efficiency within the company and at the same time

a new relationship with the consumer, although to be honest we've had a huge benefit in terms of the relationship with consumers in terms of perception. Then if you want we can go into more detail.

That's one of the next questions, we'll park it for a second so we can follow the thread. I'm going to ask you what are the main benefits to consumers in a BC system versus the traditional traceability system if there is one for wheat, and have you looked at other alternatives to certify these processes.

No, we did not want to evaluate other alternatives because we are happy as we are, in the sense that we could see that the consumer, thanks to the BC system, has the possibility to check when he wants, where he wants, doubts. Above all, in our case, they can try to understand if the package of pasta they have in their hands has a history, let's call it only linked to our pasta factory. Many times one might have a doubt: is it possible that all this pasta is made by one company and that they are always the same actors? It has always been a commercial issue, a problem of perception, not one of the biggest, but one that we have solved or buffered thanks to BC has been precisely this, to be able to demonstrate and make sure that no one had to pick up the phone or reach us in person or get involved in other ways in the work that we do, and we are happy to have them do it when a person is curious, but the ability to do it with a smartphone from home in Italy or on the other side of the world is a great advantage and we are happy with this.

so has BC impacted the level of trust between you and your consumers? If so, how, and on the quality level in terms of loyalty, purchase intention, loyalty... what are the drivers on which it has had the greatest impact?

Certainly trust has been one of the aspects that we have gained the most, but there is a small premise to be made. In my opinion, beyond a question that could be formulated in a standard way to a company, especially a large one, we can think about BC in many ways. In our case we have a company that is already chosen with the trust of the consumer, because the positioning of the product we have is high because normally the fact of having a company that declares itself as an agricultural pasta factory already puts the consumer in front of a choice: why do I want an agricultural product or one that is declared as such? Because I like the idea that the raw material comes from or is known or manipulated by the same people who make the pasta, so we have had a very high level of trust from people who already gave it to us, but

at the same time we have had a great response from those who were skeptical or who have heard for the first time of an agricultural pasta factory, therefore of a method that comes from industrial or artisan pasta, which are usually the two poles around which the consumer's choice is structured, and heard about it because articles came out that told about us and how we built our BC platform and therefore we were accredited in their eyes. There was a willingness to go and see if actually what they do is true and how they do it because it's an unusual thing.

At the level of QR code scans on products do you have high, low, average feedback in your opinion?

They are high, certainly because they have been combined with a social communication of ours quite punctual and they will be growing because they are still coming on the shelves, we do not have all the packages today traceable on the shelves of stores already with the QR code. But the rotation is high and we count by mid-September (this thing started in March) to have a product always or almost always traceable with the QR code. We have seen that people are curious about the platform, they go to see all the pages, they go especially to the page dedicated to traceability where they can learn about the 4 macro phases that we wanted to do, that is, the time of harvesting with the start and end dates of threshing and the quantity of wheat grains harvested and stored, the milling phase in which we go from raw material in the form of grains to semolina, and the quantity of semolina obtained on a given day, and then the last two phases, which are the transformation into pasta, i.e. bronze drawing, with the specific date and production lock, a quantity that identifies the passage of a certain quantity of semolina to a certain quantity of rigatoni, for example, and then the number of bags obtained from those rigatoni produced. The nice thing is that we've seen that the 'proof of 9' button, the one where you go to see the actual transaction hash on the BC register is also being consulted a lot by consumers. Then, to say that it's pure curiosity or a trending issue, I don't know, either one or the other can be true. What we do see is that anyway the traffic is there and then it bounces back to our site and the various channels that we have.

So can we say that consumers have rewarded this choice?

Yes, consumers have welcomed it enthusiastically, partly because they saw it as a way to be even more transparent on our part, but I think as on the part of every producer. In my opinion, the consumer is aware that, being a trend, it could also be a situation studied at the table in which the producer says: I create my security and declare data that make me feel comfortable

that if someone goes to check they are always logical, sensible. From our point of view is real the responsibility that we feel, even more so with BC, because every department of our company internal knows that everything that is done then can be found outside and certified by this sort of digital notary, both the mill that is not a phase that we have inside in the company, in turn has a sense of responsibility because they too despite being external are involved under this magnifying glass.

and in terms of brand value, how do you think it has impacted?

I think it has contributed to give value to the brand and its mission, that is, we in a market as I explained before that is stopped on two poles very distant from each other, that is, the industrial pasta that is seen many times with negative perception, because you have certainty at the food level but at the same time you think it is not all transparent, you can not really know how long something is made, I do not have the perception or the opportunity to go and see the fields from which the grain comes and I have a little bit of distrust, and the pole of the artisan, then the world of Raniano (? Min 14), which in Italy is perceived as the home and the district of artisanal pasta, and then this other way of making pasta that is more like that of a wine producer who has his vineyard and his raw material, in his case the vines in ours different varieties of wheat, and he makes pasta that has a vintage and that every year is the daughter of a harvest. Let's say that in a world that is quite static like that of pasta, the fact that we had BC technology and implemented it quite quickly, even under pandemic and therefore at a distance, allowed us to be able to tell and open even more doors on how we make pasta from a farm pasta factory, so the feedback we had in terms of perception was positive.

So it's changed the consumer experience yes because they go to the website and they're curious about it, what we were talking about earlier, and do you think the investment you've made has paid off or will it pay off? If yes or no why?

I think it will be paid back maybe like all things pertaining to the world of communication gradually, slowly. We will see it more and more in the long run. The fact that we have had the opportunity and the willingness to communicate that we have harvested a lot of wheat this year and we will make a lot of pasta, which is what you have in your hands in that amount... at the same time I think there has been a short-term benefit, because we have had a lot of attention from the press, but I am not a specialist. Just look at the articles that were dedicated to us by the corriere della sera. They were in-depth articles, they wanted to know as you are

doing with an investigation or an interview what was the implementation that we as pasta producers had brought to our world. Also the Sole 24 ore. In my opinion, the benefit and the economic investment can be said to have paid off, and I think we will continue to benefit in terms of communication without being too scientific in this, because we communicate the truth of the work we do, it is not something studied or structured ad hoc, just because this is the trend, and so yes, we can consider it paid off.

What is your consumer's level of maturity towards this technology and how is it changing in the last few years, in your opinion? Are people capable right now of understanding what it is or is the feedback still slow?

In my opinion, people are able in general to know that there is one more tool at the technological level that can give you news, can make you more aware. Then specifically our audience is also quite younger than the average pasta company, we definitely have a group that is over 40 or 45 years old that always sees with a lot of distrust this type of tools, because it is not the generation that grew up with this type of digital innovation and because it is not very practical, so the unfamiliarity often goes hand in hand with distrust. At the same time the fact that BC in my opinion has also had a somewhat controversial communication on the Internet doesn't help that kind of audience, because you always think that BC is something obscure and therefore all the more linked to conspiracies. Who manages this technology that has no one to take responsibility? These are phrases that I try to bring back to you directly. You don't see who certifies the information that is given, how can you trust it? Legitimate, it would always be enough to have sources of information as accurate as possible, but we see it, this happens across the board, the distrust today in the network goes from vaccines to the last iphone released that tracks you, you don't know, I heard... in my opinion a little more digital culture wouldn't hurt.

So the younger audience rewards you while an audience over 40 is more wary?

Yes, if we use the label 'millennial', today a millennial comes to buy pasta at the point of sale and immediately goes to scan the QR code, he does it automatically, as if it were an extension of the normal way of buying. So yes, it rewards him, we also see it in the social, the news of when we went out with FB, with IG of the QR code available, I did not see backing out young guys who commented 'nice, contemporary

Coricelli

1) For what reasons have you implemented blockchain for process traceability? (efficiency of operations. relationship with the consumer). If both: which one weighed more in your choice

Everything stems from the desire to ensure maximum transparency and quality to consumers. and we have given shape to the need to digitize processes looking to the future. With the birth of the first line of traced products of filiera "Casa Coricelli" that tells the journey of Coricelli oil from the field where the olives are harvested finally to the scaffale. The IBM Food Trust blockchain implemented in 2021 we added a further step. This project wants, in fact, offrire digital content of tracked quality, maximum security and help the consumer to make a more informed purchasing choice applied to the best-selling product, our Extra Virgin Pietro Coricelli. This further step - through Qr code placed on the label - allows us to have a point of contact with the consumer that we did not have before.

2) What are the main advantages for consumers of blockchain compared to a traditional traceability system?

The blockchain is a digital ledger that allows us to certifiy that any data transcribed at any given moment in time, remains at the click of a button forever, without the possibility of any modification. In our case, as the first Italian olive oil industry to choose IBM Food Trust blockchain technology, we decided to focus on transparency and security.

we decided to focus on transparency and to create smart labels where we can share the path of quality of our product (chemical analysis, panel tests, etc. ..) that become an immutable identity card on the product. This allows us to extend our communication channels. We have

also chosen the most sold and distributed product so that all our consumers can access the certified reference.

3) Have you evaluated other alternatives to certify the origin? If yes, why did you choose blockchain?

On provenance, we had already launched the aforementioned file trace line. The IBM project wanted to go deeper, because the origins of an oil are already clearly indicated on labels by law, while the quality path that each oil passes before arriving in the bottle must be the real must required by the consumer for safety and transparency.

4) Does Blockchain have an impact on the level of fidance between you and your consumers? If so, how?

Blockchain technology offre an added value because it offre consumers the possibility to access numerous contents about the product they find on the scaffale and therefore be able to choose with greater awareness the extra virgin olive oil to bring to their table. All this gives a greater guarantee of quality and increases the confidence of our consumers.

5) How has blockchain influenced the perception of your brand/company? Have you had any feedback on this? What aspects have been most impacted (brand/company image, credibility, supplier relations)?

We immediately received important feedback from our partners, suppliers and customers. Ours is traditionally a static sector, we have chosen to invest in innovation while maintaining the values that have characterized us for over 80 years, treasuring the experience that has been handed down for three generations but having the courage to look to the future. The entire path of sustainability and transparency that we are pursuing has a strong impact in terms of brand awareness and credibility, there is a lot of attention on these issues, today consumers are much more sensitive and this, together with numerous requests to bring our experience as a case history, gives us confirmation that we are on the right track.

6)Do you think that the investment you have made has paid off/will pay off? If yes, why?

We are certain that it will be repaid, perhaps not so much from a mere commercial point of view but certainly from a reputational one: a transparent company is a safe company.

7) Do you intend to invest in raising consumer awareness of the benefits of this technology? If yes, why do you think it is important? We think it is fundamental to make consumers understand which are the safety parameters to be monitored in an oil, beyond what is already provided on the label. Our dream is that this project can lead the way for a cultural growth of the category.

8**) Do you think that in the future this technology is/will be a key difference factor for transparency towards customers? Absolutely**

9) **Is there anything you would like to add about blockchain and the fidelief relationship with consumers?** fidelity is the foundation of any relationship, and for us as a family to have the opportunity to welcome our consumers into our value circle is critical to building the future

Foodchain

1) What reasons do firms implement blockchain for process traceability? (efficiency of operations vs. consumer relationship). If both: which one weighed more in theirr choice

Difference between small and medium-sized companies and more structured multinational companies. SMEs have a niche production of products with higher quality than those produced by 'mass industry and seek a footprint on the customer that gives a little more impact than others choose an enabling technology to ensure traceability and origin to the final consumer. Multinationals benefit from the fact that, as they are usually complex systems, this technology allows to put all the actors of the supply chain and stakeholders (certifying body, auditors, quality control and third parties), governments (regional vs. national) the information is managed with transparency and integrity and this allows all actors to operate in an advantageous environment, both for operation and for quality of information. Timing Benefits. Information is exchanged peer to peer without an intermediary, without a third party verifying

its authenticity. Example: SME a rice company that put on blokchain the information for a particular technique of planting rice. This type of traceability allowed them to demonstrate that the level of selenium in the rice was below a standard threshold, which allowed them to access the market for children's products. This was possible because they were able to show, through the tracing of the supply chain, the relative information that could be used as proof of what they were going to declare (to the certifying bodies), which otherwise would not have been possible or very complicated. In this case there was a large producer and nurseryman who did not make a mass production and did not sell directly to the large-scale retail trade. The information they collected at the top of the supply chain was then able to filter down to the final client. The second study: A multinational company working in the palm oil sector. It involved producers, transporters, government agencies, banks, etc. The advantage here was that if the small producers had liquidity they would be able to survive. This does not happen because there are delays between the release of funds and the request. As soon as the bank and the smallholder are put into a single system in which the information is not filtered by an intermediary then the release of funds comes immediately. Currently the process is much longer, as it takes 7 days for the smallholder to have the funds and send the goods, so the goods remain 7 days in the warehouses and cause delays throughout the supply chain. In the moment in which instead the solution has put all together all' inside of the ecosystem the request of the farmer and the release of funds by the bank would have been immediate, then even if the funds themselves had not been virtually deposited all' inside of the bank, this' last one was registered in blockchain therefore they were guaranteed the immutability, safety, transparency of the transaction and this acted as a trigger to the smallholder that could send the goods and ascertain that the funds had arrived. In this last example more actors are involved that are not strictly related to agribusiness, such as banks and regulators. These players, placed within this ecosystem, can cooperate to leverage the strengths and benefits that the technology could offer. This then changes in some way the relationship of trust between the parties, and this is one of the key points of change between centralized systems towards decentralized systems, as until now the actors are masters of their own decisions and if you want to access information you have to ask permission to the actors who can accept or refuse to provide it, then also with the power to provide only a part of information selected by them and therefore by nature not complete and transparent. Trust is therefore no longer the third party, but towards the technology itself, precisely because mathematically it can give guarantees. As far as maturity

towards this technology is concerned, there is still no maturity, as this is an emerging technology and therefore before being adopted it must be understood.

Technology moves faster than politics and laws, and as a result we can see that the market has demands, such as transparency and product information, technology can solve these kinds of problems, but technology is still in its early stages, in Italy the legislative framework is not yet 100% mature, It is not 100% on the side of the public and the market, because it is innovative, new, relatively new, so the adoption is not mass but gradual, which goes hand in hand with the maturity of the customer and the market that adopts it and the maturity of the legislative framework that encourages its use. We are witnessing big efforts and big funding that are coming from the European community or state investments of the PA for this technology: in some public tenders for example blockchain technology is expressly required. The problem is that it is a long process, a paradigm shift between centralized technologies and decentralized models. There are the first investors that despite the political framework is not fully mature, despite the technology is not fully understood the first investors jump in and use the term "blockchain" for marketing purposes. At the moment, whoever implements the blockchain technology has an advantage in terms of return of image given the novelty of the technology, that businesses that implement it can exploit. There are those who stop at this and there are those who continue to have advantages because they continue to invest in this solution and do not stop at the mere return of image. Blockchain technology cannot be owned, as it is decentralized by nature. It follows in the wake of open source technologies.

2) Which benefits do you clients achieved with implementation of a blockchain system?

Awareness, willingness to spend more for a product that turns out to be of higher quality than the competition, on the use of fewer pesticides, while the aspect of communication is also important: since adopting blockchain solutions at this time has a strong media impact and is certainly an important parameter to consider.

Advantages at the operational level as the time of exchange of documents, all 'within the' ecosystem (in this case that of coffee), improving communication not only with end customers who can trace the history of the finished product, but also has improved communication and trust of its employees all 'within the supply chain by moving from excel or pdf documents to digital tools, digital tools with the potential that gives the posibilità to go further. As far as made in italy is concerned, saying made in italy is very permissive in the sense that it is enough

that the last step in the chain is made in italy that the product can be declared made in italy. For example, tomatoes grown in China and then arrive in Italy and are processed even partially in Italy can be labeled as made in Italy, as for clothes and everything else. At the level of legislation the traceability is not so tight, while what the market wants at the moment is to go beyond the legislation that is no longer so tight and do not trust the brand or the label that proposes it.

And this is what pushes the business to try through technology to demonstrate the veracity of information. Producers then with a product of superior quality try to demonstrate this feature to their customers, to make space between the competition and have a lever of differentiation from others.

In this moment on the shelves almost no product can have a complete history. The products that do have it, therefore, can have a price premium because they are able to directly communicate the added value.

Copy piece that lacks confidence in multinationals, that people require confidence in the product.

The reason why companies adopt it is also the communication of the product itself in the product itself, including a storytelling where the values and characteristics of what is inside the product are communicated not only to satisfy what the market demands but also to leverage what the technology can offer in terms of added value, as for example in the case of selenium was able to leverage something that was not the primary objective. In a certain sense, this technology is capable of opening lines of business that otherwise could not be opened (as in the case of Selenium) or new businesses that take advantage of the unique, innovative and new character of this technology.

Another example of a new line of business is that of Gelateria Marchetti: the latter has implemented the traceability solution. Gelateria Marchetti has partnered with San Domenico for the first "tracked" gelato. This is the testimony of how a company that communicates the quality of a product (Gelateria Marchetti won the award as the best gelato shop in Italy) can open new business opportunities (also B2B) of mutual benefit. In this case, the traced coffee

beans used as an ingredient for coffee flavored gelato had a significant impact on the perceived quality of the products:

in fact, customers appreciated being able to see where the raw material came from and how it was processed, and they associated this modus operandi not only with the coffee flavor, but also with all the other flavors, thinking that the approach was the same on raw materials. This had an impact both strengthening the perceived quality of the product and the position of the San Domenico ice-cream parlour, reinforcing its brand, so much so that it was then implemented also on a second taste (fiordilatte) tracing milk as raw material. Moreover, the fact that it was the first "traced ice cream" had a considerable media impact given the unique and innovative matrix of the product.

What about ROI?

Return of investment: If you ask "competitors" maybe they will give you a different answer, it depends on the way this technology is implemented. The way a blockchain solution can be implemented is varied in nature, as different models can be built. When you have a solution where the customer just uses the platform, no skills are needed, no IT departments are needed, no code is developed, there is not that kind of effort and so at the end of the day the economic effort is focused on paying a subscription.

This model allows SMEs that do not have funds to knock on the door of big giants like IBM and microsoft, an affordable solution, especially aninterwieweeche because in Italy are they who offer products of higher quality that needs to be communicated to the customer, compared to multinationals and food industries that produce at industrial level and therefore the quality must necessarily pay the price of 'industrialization. Let's say that there is not a big investment in this type of solution and this makes it accessible to anyone. Those who have the funds to build an ad hoc solution and do not want to use a third party software, then the investment will be greater. The return on investment will be there not only for the benefits we have mentioned above, but especially for a level of alignment to a level of standards that are not European, are not national but are global. If on the one hand we see that state and parastatal administrations are espousing this technology and therefore standards will be born to comply with mentioning blockchain and distributed systems, those who do not have such a system will be cut off. Both with regard to the public sector, as for example with the certifying bodies may not grant certain quality certificates, both in the private sector as suppliers will be required this type of

tecnolgoia to prove and prove this type of information in their supply chain. While in the first case it will still take some time, the latter is much more common in the large-scale retail trade. The tendency is to abandon more and more paper documents to approach a higher level of security. Although the regulatory framework is not yet ready, the push is coming from below as companies have requests and the technology that has been identified as the most suitable is the blockchain. This is happening because the private sector is moving faster than the public sector, which has to include laws regulations and experts, however, the direction is there and those who see it through instead at the business level are starting to work on it now so as not to be cut off. For example, if in the supermarket shelf there are 4 brands of products that sell meat, say chicken, and on the shelf among these four there are 3 with QR codes that tell you the story, the origin, the traceability of information and one does not do it beyond the law, the customer will tend not to choose the one who does not do it. To level of benefits a po less tangible c' is sure the fidelizzazione of the customer in how much the company that plays to paper discoveries comes rewarded regarding an other company that me does not give of the information where the customer has of the interest to know.

Latteria Valtellina

We have good relations, therefore we are recognized as a reliable company, as a reliable cooperative that allows us to create serious relations with the institutions, also to avoid that the Lombardy region itself makes bad figures, for example when it presents a project and fails to present the data; so on the one hand there is certainly an institutional part that already has good relations and good answers with us; last but not least, a last project that we have carried out with the psr, which is the reference tool for funding that the region of lombardy provides for farms, cooperatives, so the agricultural base of lombardy, the project that we presented was selected by the ministry of agricultural policies for which we have benefited from almost three million euros in funding, just to make you understand that there are close relationships because the things we do we say, and we apply them; on the other hand, the relationship with the institutions, with the breeders, who are often very small farms, the average number of animals per company is 47, they are small, they are not companies of 500-600 heads, which are entrepreneurs ten times our company: This means that all these technological advances allow the agricultural system of Valtellina to grow and to understand that it is not just a milk round, but there is also an infrastructure of data, of technology that must necessarily come forward to

face the market, therefore benefits also to grow the level of the livestock system in the province of Sondrio.

question: so in this project the value of the ecosystem has grown, both as far as you are concerned that with the customer you have had greater transparency, which will certainly have had an impact on the level of trust of your customers, on the other hand the ecosystem has also grown, if I understand correctly, as far as the breeders' side is concerned...

answer: there are three levels of interaction with regard to clients: institutions, breeders and clients. The clientele, closing the agricultural side, not only in the quality of the raw material but also in the quality of the processes, which today's consumer demands for the big players (granarolo, parma etc..) that need to show that "virginity" that they have lost for a long time, so let's say that our size, our territorial area allows us to trace that territorial matrix that distinguishes us, which certainly has grown in the consumer: in fact it would be consumer-customer, so end-user who uses the app and traceability to find out who the farms are, etc. etc., but also the business customer, the large-scale retail buyers who are attracted by this system of guaranteed traceability, since they are things that consumers require in turn, or at least are assumed to require. There is always a series of elements: loyalty to the brand, sympathy, etc. that certainly improve the approach to the end customer.

question: So has this process of seeing the information improved the trust of your customers?

answer. sure, it has definitely made the company take a leap forward.

question: So what is being rewarded over another competitor?.. as far as large retailers are concerned, who are more interested in the business side, what are the factors involved in choosing one supplier over another?

answer: a series of factors that concern the company base: first of all if it is reliable, if it has certified places, therefore a whole company structure able to be reliable and to be able to serve with particular quantities, logistics...; It also counts the quality of the products that must be good and, above all, constant. question: the tracking of processes and data by large retailers is therefore autonomous? answer: certainly to provide for example an esselunga you must have a quality structure, a commercial body, a governing body, a series of elements that in fact do not allow some suppliers to enter, because there are some prerequisites to be able to enter, then all that is the mechanism of the structure, which is considered suitable for the quality level of

the products they buy, of the transferable characteristics of their branded products, then you must have the ability to produce different products of their brand, have products that are in demand by the final consumer, and have innovative products, then the structure. values, and having products that are in demand by customers are factors that make it easier for you to be chosen over another competitor. For example, we have been suppliers of esselunga for forty years because we have fairly good products and certifications and these are the things that probably helped us to be chosen over other suppliers. question: so in the future a company that decides to invest in this technology knows that this technology can open up new lines of business? answer: sure, but the quality of the product may be less important than other factors. Q: "so, for example, safety..." answer: a number of things, but the factors that allow you to be chosen over other competitors are those listed above. question: as a last question I wanted to ask if the supply chain of milk and dairy products was a short or long supply chain answer: for us it is a zero kilometer supply chain. question: what I meant was if it was a supply chain with many intermediate steps or not answer: the length of a supply chain is counted more in the kilometers than in the intermediate steps, so for example a zero kilometer supply chain is considered short and vice versa.

Consorzio Arancia Rossa

What are the reasons that prompted the consortium to implement blockchain?

We wanted to give services to our members, because as a consortium of protection we always find that being enrolled in a PGI does not give that added value to the product of being subject to a quality consortium to the producer, that is, the trader who comes does not pay those extra cents that could have a quality chain. The producer without blockchain will never get that added value.

We asked ourselves why a producer would enroll in our consortium five to six years from now, having seen that there was only a small contraction of members, instead there was a better response and consequently an increase in enrollment when the region issued notices in favor of protection consortia.

So we set ourselves the goal of helping producers by offering them services and working against counterfeiting, particularly on traceability.

When it comes to blockchain of certified traceability, we are there, as it falls within the requirements, so we decided to start with that.

We give our producer the opportunity to make themselves known and to get in touch directly with the consumer, putting them online through an app, also giving them the possibility to be able to put inside the app all the descriptions they want, thus creating a communication service for the producer.

On the other hand, we are also the first to make it possible to guarantee visibility to the consortium, an aspect that is underestimated by others. In addition, having the traceability of the product, we can make analysis of sales data in order to know who has sold, to which distribution and to which country, making feedback we will be able to understand how to act through a statistical support.

So the starting point is the consortium, as he decided to start with the blockchain; all the implementations have come to us also thanks to the suggestions of AlmavivA, which has directed us to this new world.

But the producers were already IGP and the consortium gives them added value?

The protection consortium has two roles: the first is that of controller, as it controls the areas registered in the production area, controls purchases and verifies whether the productions carried out actually coincide with sales; the second role is that of communication and promotion.

How does the "don't pay that extra penny" issue, mentioned earlier, work?

I am an orange producer and when the trader comes to Campania he tells me "I will give you 50 cents" but I counter by saying that I am a PGI producer and consequently I want something more, as I want to be paid the registration/data registration costs etc. The trader will not give that cent. The trader will not give that extra cent. On the other hand, in the organic sector, it may be that they give that extra cent. Not all producers receive this added value. When the trader buys PGI, he gives a certain amount because it is obviously more valuable, but if it is sold with its own brand, the trader will want it at a lower price. Therefore that penny does not fall on the production but is taken by the packer; however this is not good because then the

consortium without production is not a consortium, it dies. This obviously concerns all types of consortia.

How is the orange chain? Long or short? In terms of intermediate steps?

Directly it's very short, otherwise it's very long because there are packaging platforms, intermediaries, large-scale distribution.

And has this blockchain implementation had an impact on the chain? Where has the added value of traceability been found?

It's been found for those that are e-commerce. That's because when you're buying you can be sure and comfortable, so as far as the consumer is concerned it's been very much appreciated in the e-commerce sphere.

In the GDO sphere, on the other hand, there was already a traceability because the latter requires all the documentation but if this documentation becomes virtual and editable it is much better for them.

And for e-commerce mainly it's because of counterfeiting?

Yes, because the consumer is happy. He tracks the manufacturer, and he is certain, it gives him security. It was implemented for the Chinese who were happy with it (for exports to China).

So for e-commerce we have Italy and for export we are talking about China?

So for e-commerce, Italy definitely. We in Italy have difficulty to find blood oranges, instead in this way they are certain. Italians consume a lot of blood oranges, they are among the biggest consumers.

As far as foreign countries are concerned, we had all made it for the Chinese exporter who wanted to import it as an innovation in China, so we asked them to implement it. The whole thing is more about marketing, not traceability, because we have no jurisdiction over that.

So are the major benefits in terms of consumer images or is it more about the possibility for you to have control or is it somewhere in between?

Absolutely the control on the land is certain, we did it just for that and it is much easier. From the platform we can also read the data in real time. On an actual or percentage level, I can't say for sure, in the absence of data, that it's better for the consumer.

Certainly, these are qualitative considerations in newly implemented areas of best practice research. Everyone puts in their own contribution like one brick at a time and the end result is a castle, that's what my research is all about. On a qualitative level, what is the impact you have had on the consumer?

An example, I go shopping and I really like technology so I tried to make things simple because I understand that it's not easy to use. Our app is not a personal blood orange app, but talking to coop and Conad, they can integrate the app into their system. We don't need to have our logo, we don't go personal but rather practical. When I go shopping and I click on the oranges, the tag or the qr code, I immediately see the Conad supply chain or the Coop supply chain, I don't see the transition from Coop to my app because the platform is open.

So you can't see Coop data because Coop has it?

No then this is from the consumer's point of view. From the consortium's point of view this blockchain is hybrid, consisting of a confidential part and a public part.

From which the reserved part is made for Coop, Conad ?

Yes, but it is for the consortium, because I am actually aware of how many tons of oranges have ended up in large retailers and in which ones. That reserved part can only be seen by the consortium, not by Coop or Carrefour.

Therefore, the retail sector manages the sales part, while the production part, which is of interest to the consortium, is used to find out how many oranges have left the consortium? Is this correct?

Absolutely, yes. I need to know where the oranges have gone until they reach the consumer. If I sell to you, who are packager, who sells to Coop 10 oranges. Then I have to have the

production that produced 10 and Coop with the name, gives me back the figure 10. So I know it is 10 because the packer told me 10. I cross the data.

But you can see the data of the large-scale retail trade?

We can see what the packer has declared. Then Coop has the obligation every year to send the things and tells me who are its suppliers. So we cross-reference the data and see if there are any differences.

Is this control on production important?

Because the role of the protection consortium is to control, in fact we have the control systems that actually verify who the producers are and what they have produced; the vigilance agents that go to the point of sale and verify that the suppliers are those declared. If, for example, Carrefour declares to me that it has taken 10 tons from Mr. Rossi and Mr. Rossi is not registered, it is a real fraud.

Therefore it avoids counterfeiting and fraud? What about the difference from before? Were you still able to do this or is it different?

Sisi just the fraud. Yes, but with an Excel file that is much slower, the copiousness of data that has to be uploaded and the presence of errors.

Instead, what have been the biggest findings at the business level?

The consortium does not do business so from a marketing point of view, huge feedback. The packer has had more credibility. We do not intervene in business, we are non-profit. This year there was a longer season, so more PGI was sold and we increased production and there was a demand.

Is this demand being implemented by large-scale distribution?

Yes, absolutely, but I can't say if this is due to our better communication or if traceability has also contributed.

Has this demand increased from mass retailers?

Yes, absolutely, but I can't say if this is due to our better communication or if traceability has also contributed.

Has it opened new business opportunities for you? I ask because some helped by blockchain have opened a market that they did not have before.

To us no...this has not changed much, however there are new types of implementations that we are developing and it is not only blood orange , but all derivatives of oranges (jams, soft drinks such as Fanta)

Processed products are all enrolled in the consortium and through the blockchain they can use the platform. A bit like the gdo , the end point where then there is the purchase of the consumer. For example fanta, when I write to you that inside there is IGP blood orange and the blockchain you can be sure that it is something of quality and not colored sugar and water.

As a consortium do you plan to invest in raising consumer awareness of this technology? Have you already done this at the communication level?

No, we don't because we need to raise awareness mainly among our producers. In the countryside it is very difficult because the average age of the farmer is quite high and therefore they have lost the technology. There are large structures that are very active technologically, while there are others that are still traditional. Fortunately for technology we have a generational change, so there have been and are a lot of young people taking this path of life.

And has that caused an increase in sales?

Yes.

And has the positive feedback from direct sales been on e-commerce, in that those who wanted to buy that product have done so with confidence?

Absolutely. Obviously when you have to buy a product almost all of us use the best known platforms, if we go on the platform of the manufacturer, maybe it is also done well but sometimes disappear.

What is the volume of e-commerce compared to the total? Are we in the order of 1% or 10%?

It has increased a lot, I don't remember precisely but certainly more than 10%; with the pandemic it has increased a lot. However, we do a lot of online controls and also ICQRF (repression of fraud) and we have found sites that used our simulation without being registered, but only because they fell in the production area.

Is there an aspect in general that you would like to deepen or that we have not dealt with?

In collaboration with AlmavivA we are reasoning and ranging to understand how to lengthen the entire supply chain, not only with the normal supply chain but also in virtue of the green deal, in short, to put everything, even the packaging.

So extending not only the product but also everything around it?

Yes, exactly. For example, packacing: include all those who do packaging. Precisely those who do packaging will say that they do unique packaging for blood orange, each of them will say how much packaging they have done; consequently I know how many oranges have been produced and then I calculate how many packages they can fit in. If there is more packaging it means that someone produced more oranges that were not placed under our control.

Is this both for a control issue and to add value on the data you put in for the consumer?

Yes, but also for the packaging companies, because they make the supplies and they can have forecasts as well and benefit from the statistical data. Whoever wants to make unique packaging must be enrolled, we send the indications and then we have to view it; obviously we have not given authorization to everyone, but only to those who have a certain level and excellent quality. There is more control and yet we find many packaging forgers.

For you it is control but for the packaging manufacturer the biggest advantage is what?

Being known and that means that that is your carton, that is your packaging; in a way it is always marketing.

Is the goal of production to grow the value of the entire ecosystem, piece by piece?

Yes, the value that characterizes the whole supply chain; there must be a common growth because we have to create the orange world, a serious and quality world, which works well and represents Italy and Made in Italy.

Pralina

For what reasons have you implemented Blockchain for traceability to processes? For a speech of efficiency of operations (so within the supply chain) or did you do it for a relationship with the consumer? If it's both reasons, which one weighed more in your choice?

We did it mainly for a question of transparency. The idea was to be able to trace a path of production chain that went from the land to the table, upstream of the application of the Blockchain, was an agreement made with the producers already the previous year. The Blockchain has been applied to a project called Biodiverse, which is a line of soups and velvety soups made with local legumes and grains related to the biodiversity of the territory, grown by cooperatives of young farmers who have returned to cultivate land abandoned for some time, through a natural agriculture, organic sometimes not certified, as they are very young, with the land in conversion, but certainly pictures of a sustainable agriculture that is good for both the territory and the health of people and then for those who eat the products. Therefore, given that at the base there is this corporate and social project of recovery and enhancement of the area in which the company is located and its natural and human resources, it was decided to apply to this project, which starts from a memorandum of understanding in which the company is committed to buy all raw materials the previous year to allow to put in the crop the quantities that will be used for the processing of the product at a defined price, the maximum transparency of the process: to make known therefore the producers , to make know the production chain from the cultivation in the field until the delivery to the company, the processing, the potting of the product, the storage and shipping. All this in order to make a choice of total transparency to the consumer and establish a relationship of trust and value a production exclusively Made in Italy, absolutely territorial.

So it wasn't a question of process efficiency?

No because in fact we already have all the automated processes, we already have a management system, a harrow (?) that traces the entire process from the arrival of the raw material in the warehouse to the purchase, the arrival in the warehouse, storage, unloading of stock for production, sterilization, labeling and shipping. We simply made visible through an

interface what was already happening at the business process level. So the Blockchain hooked into the management system extracting data that was then made available to the consumer.

What kind of Blockchain do you use and what kind of information do you record?

It's a Blockchain on the 'Quadrance' platform, so the public one.

What advantages do consumers have in having a Blockchain tracking system versus a traditional tracking system, if any?

The consumer with a QR code, which is printed on the label, can see what he is eating, where the ingredients that go to make up the finished product he is eating are produced. He can, for example, see the chickpeas where they are produced, that is in Melpignano and in which garden and which owner. If he/she wanted to, he/she could make a direct verification on the spot of what he/she is reading, he/she could decide to go and meet the producers of the raw materials or to go and see the company producing that finished product. It is not a simple statement, that is, it is true that it is based on a statement but they are statements that can be verified constantly and at any time. Also, which is the very concept of Blockchain, which is that the project is freeze-framed the moment it is tracked by Blockchain, any modification or change after the event results in a chain change of everything else, so everything is completely tracked.

Could you guys do this with a traditional traceability system or not? Could you declare the same things with a traditional system?

Certainly we could declare, but we would not be within a Blockchain system where any change is tracked as a change within the system. So any change, in addition to remaining frozen in time and therefore not refutable, remains tracked. In a traditional system I declare what I want and show through the QR code what I write on the site, I show you the webcams but I do not question myself by giving the information through a system outside the company. The Blockchain, in fact, is not a system owned by the company, but public, which finds the information of the management system and once made public remains so. Any changes made to the management system remain visible to the consumer.

And are these features understood by the consumer in your opinion?

Maybe not yet because there is not much education about the blockchain, however, it is definitely something that will grow from here since all the big multinationals are looking at it.

Has the implementation of this blockchain had an impact on the level of trust between you and your consumers? If yes, how? And also on a qualitative level whether in terms of consumer behavior, in terms of purchase, in terms of consumer loyalty?

In terms of purchase consider that it was launched in November 2019, just before the lockdown. This one that we applied the blockchain on is a product of almost seasonal use (September to March/April) as it is soups and velvety soups, and it was designed for a food-conscious consumer but with little time to cook, so for a h24 consumer at work. Due to the lockdown that forced us all to stay at home, the attention we had received towards this product also from companies with large canteens and with many employees who have the problem of managing lunch in the company and who maybe also do catering services, and the large delivery food companies have closed or stopped. We've been a little bit penalized in that. We have seen a lot of attention from the press, from consumers on our e-commerce but the large numbers have stopped because of the pandemic. We're counting on picking up that slack now, hoping people can get back to working out of their homes.

Have you seen an impact on your e-commerce?

Consider that our e-commerce has all of Praline's products not just the biodiverse. So the biodiverse products have gone but, as I said before, being a new product has received a lot of attention from the press: we have been published on "cucina italiana", on TGcom24, on Repubblica, that is, there has been a lot of media attention and above all attention from sensitive consumers. In other words, a series of supplies were starting and then stopped with the lockdown. Clearly some types of supplies do not replace e-commerce because if I have the time to make soup at home, I do! I will then be able to answer this question when it comes back to working in the office. We were also invited to participate as an agribusiness company at the Tourism Exchange in Florence for the application of Blockchain and how it can connect even if applied to the food system to the story of the territories being aspects, tourism and food, that can interact with each other. But I can't give numbers or any kind of evaluation, I

can tell you what happened but in terms of numbers, since the main market is blocked, I don't even have a margin of comparison.

As far as consumer experience with your products is concerned, has it changed? And if so, how has it changed? Have you had any feedback in terms of scanning, time on the site?

In this case I honestly can't answer you because it is a product that is not the core business of the company and then, in fact, it couldn't even become so. We export to almost 30 countries in the world sauces, dressings and now we are growing a lot with baby food in private label for Saudi Arabia, for England, so this is just a project of the company on which we are investing and that is a tool that we wanted to acquire both for us but also to make it available to any private label quality who want to certify the production Made in Italy. Blockchain, in fact, has as another great advantage that it can be a tool against the various counterfeits of Made in Italy in the world.

So we say that business partners reward this choice?

Certainly it is a choice towards which we have had a lot of attention. Clearly we will move with the growth of consumer awareness.

So at the business-to-business level, how has there been an impact?

Again, again, we're talking about two years into the pandemic, so, it's hard to say right now. There was attention though during the pandemic when the supermarkets were emptying. What they were asking for were sauces of any kind and that was it. They didn't care about quality with empty supermarket shelves. Unfortunately, it's a difficult assessment to make now as it was not a normal market condition. Surely the lockdown will also affect people's food choices and therefore I am convinced it will go towards an even greater increase in awareness.

Regarding the perception of the company's brand or product have you had any feedback?

Absolutely. As I was saying, we have received a lot of attention from the press, articles have appeared in important newspapers in the food sector, as well as attention from foodbloggers,

chefs who are foodbloggers. We were even included among the 10 case histories of Microsoft, which created a project called Restart Italy, linked to the restart of the Made in Italy food sector after the lockdown phase last spring. Certainly all this has contributed and the brand has benefited.

Regarding the investment made, in your opinion, has it been or will it be repaid? If yes, why has it been paid back? Or if it will be paid back, why?

It will be paid back for sure and maybe in part it has already been paid back, but it will definitely increase because awareness will grow because there are big brands that are already introducing Blockchain and this means that the market is already moving in that direction.

The maturity of consumers is still low, but in your opinion it is growing? How is it changing?

Yes, it is growing.

And why would you say it is growing?

It is growing because the concept is starting to develop, it is being looked at by the large multinationals in the food sector, there are some who are already applying it and then there is a growing awareness on the part of consumers who are increasingly careful about what they eat and who want to know what they are eating. In my opinion, after this lockdown and after everything that is happening in terms of climate change and environmental upheaval, there will be increasing attention.

And what do you think is needed for the benefits of this technology to spread?

Certainly incentives to be able to apply it and maybe also a communication campaign on these issues, i.e. the concept of transparency, short supply chain, traceable supply chain, proper nutrition, healthy food, raw materials, quality.

Have you invested or do you plan to invest in consumer awareness of the benefits of technology? If yes, why do you think it is important?

It's important because it allows you to talk to the consumer and let them know that what you're doing is a positive thing! We communicate through social and through our communication channels the goodness of our products and of this project that keeps the whole territory inside.

So explain why it's a technology that brings added value?

For us, technology is a tool that serves to ensure the transparency of the company towards the consumer and therefore to build their loyalty and intercept them.

Do you think that in the future this technology will be a key factor for differentiation and transparency towards customers? Or if it already has been at the level of differentiation why?

It definitely will be, it will be a watershed.

Why do you say this?

It is clear that the agro-food system is so vast and the consumer is so varied that we are talking about consumer niches. I find it hard to think that in Asia they want Blockchain rather than in some areas of Italy itself, there is still no food awareness because there is no purchasing power. The market responds depending on the segmentations and the consumers intercepted to different logics and needs. So surely it will be an important watershed for small companies that can find in the Blockchain a tool to certify their quality also against the big multinationals that can afford to have the Blockchain but at the same time to have a core business that does not absolutely meet the criteria of transparency of the Blockchain. It really depends on the power that consumers want to wield.

Is there anything you want to add about Blockchain and consumer trust that you haven't talked about? Or anyway, an aspect of the Blockchain project you implemented that was particularly relevant?

The thing we cared about the most is this agreement made with upstream producers, for the rest let's say that the beauty of this tool is just the possibility to put yourself on the line and demonstrate the quality of your production. As already mentioned, it also has enormous potential in the valorization of places, territories and companies.

Chocofair

For what reasons have you implemented blockchain for product traceability?

We are developing a pilot project in Ivory Coast where there is one of our processing companies, but it will be on the Ivorian market. As far as our experience is concerned, the end user has a very low propensity to request traceability of the supply chain ... rather it is very sensitive to marketing strategies where there is information not supported by facts.... An example are the APOLLO tablets where there was a picture of a woman from a cooperative associated to this project. But she did not give any kind of traceability on cocoa, she simply said that part of the proceeds of that product went to finance a small cooperative of women who made soap with cocoa waste. On the real issue of cocoa, i.e. having paid better for the raw material, the origin, the quality, how it was grown, by whom it was grown, there was absolutely nothing. We did an analysis on a sample of consumers that we have intercepted, who were people sensitive to the issues of fair trade, fair trade and things like that, but had not bothered at all to go and see the accuracy of all the information that we said before (i.e. having paid better for the raw material, origin, quality, how it was grown, by whom it was grown) they believed that it was so, although it was not so. In the chocolate sector the traceability of the finished product (the chocolate bar) is not necessary because the consumer has no interest in verifying this type of information.

The problem is therefore the low sensitivity of the consumer?

In our experience, the Italian consumer is very ignorant about chocolate and does not cross that threshold... and we're not just talking about discount consumers, we're also talking about consumers who are a bit more sensitive... our business is developed in large part for the ecosolidarity market and, as paradoxical as it may seem, those consumers are the ones who know the least about it... in the end, the parameter they use is always price, they are not interested in provenance and have little inclination to perceive the quality of the product and what's really inside. Another reason is because in Italian culture there is not the perception that chocolate is a product of Italian enogastronomy. In the Italian consumer there is not this awareness that chocolate is an Italian craftsmanship and that this way of making chocolate is extremely linked to the traceability of the product, as much as wine, so is cocoa and chocolate, but in the Italian consumer this awareness is not there and therefore right now the Italian market is not able to understand the tool blokchain on chocolate because it is not sensitive to those issues. To have a quality chocolate you need a quality cocoa, to have a quality cocoa you need specialized operators, to have specialized operators must be paid the right remuneration to do their job. So today, the Italian consumer is not able to recognize the blokchain tool for chocolate traceability, because he is not sensitive to those issues. It works on pasta, it works on oil, it works on coffee or on products that the Italian consumer recognizes as part of their culinary tradition. In addition, the artisans, bakers, chocolatiers who use high quality cocoa, already have a product whose value is intrinsic in its characteristics, and they do not need to certify it with blockchain because they already rely on companies that make the traceability of cocoa their strength, because they choose monogines linked to particular territories. It's like going to see the production proc**ess** of a bottle of Sassicaia (a bottle of very high-end wine, with a price of 500 euros, ed.). e always talk about the Italian market.

Who cares about traceability? Traceability interests industries. Why? Nowadays most of the raw material that is processed comes from West Africa, as cocoa is a colonial product, of which part arrives in raw material while another part is already semi-finished for the industry. For example, a company that produces panettone cakes receives a tanker truck with a ton of liquid chocolate inside. Industry need a traceability because all mechanisms that use the blockchain and in some way are certified when you have a non-compliance, a contamination, you need to understand the parameters then not only as product traceability, but as quality control and compliance. For example, have you respected the cold chain? There are sensors that during the various steps go to measure these parameters, from the warehouse to the ship,

from the ship to the truck etc. that has always maintained that temperature ... if I have problems in the plant, I can quickly access all this information and see if there is a non-compliance. For example, in the passage from the ship to the truck there was an impressive drop in temperature. Do I need to retrieve a batch? I access the blockchain and it takes me a moment and I have it in autmatico with systems.

Before the blockchain, how was this kind of analysis carried out?

The only real example in which blockchain technology is used for traceability to the final consumer, but there is not a real use ... there is a Dutch company, Tony's Chocolonely that have all the fair traced in blokchain from the various countries from which we supply, to communicate to their consumers this traceability as Tony's Chocolonely was born as a brand against exploitation. But there is a problem and this I can tell you with certainty because I deal weekly with those who deal with this, the final consumer does not open the code is very rare, because it is not something that is interested in."

"Also, in this 'industry tracking all the processes that give quality to chocolate makes no sense, in"

"First of all, there is a premise to be made: the cocoa supply chain is a very long supply chain as cocoa is harvested, it has to be fermented, it has a drying time, it can run for 5 years, and the cocoa bean is used for different industries and has many other steps... Traceability instead interests the industry..."

If there were no blockchain, this type of traceability would employ many people, because there are so many steps, it is a traceability for many stages linked to paper in a cumbersome process... having a traceability with the characteristics of blockchain, which I'm sure you know, covering from 'origin to the final stage allows to homogenize all these steps and speed them up within the supply chain. Traceability is now linked to pen and paper, which is then passed to an operator who puts them on an Excel spreadsheet, which is passed to the certifying body that uploads the data all 'inside the system traces of the European Union, which is then passed to the customs broker and from that moment on the data that are passed from' beginning

to end are the data of that product. But then the company that imported the product is not the same as the one that then goes to work it, but it is unpacked for more companies, for a part to one and for a part to another etc etc. Having a blockchain system that covers all these steps allows then in addition to homogenize all these steps I also have a cost advantage, because there are no longer operators who do this type of verification. as there are so many documents that I have to receive and at each step of the chain is recomposed this picture (in 'example of a bio product that is certified), while being all interfaced in blockchain ce l 'has automatically ... so this optimizes time and costs ... this is giving excellent results ... Although this is a cost (derived from factors such as RFID sensors, payment recordings in blockchain ed.) that cooperatives that produce extensively (which make important volumes) is a cost that they are happy to pay, as it brings the benefits of which we spoke earlier and then recover it in the intermediate management and administration in the various steps for example I will have fewer hours worked than the quality manager. For cooperatives that have large volumes, we are talking about a cost that does not have a strong incidence and that is provided for in the cost per kg of cocoa ... Obviously we are talking about supply chains that have a size of one hundred tons or more, otherwise it would be a major investment that you make only if you want to use this traceability for marketing purposes. For example, the only real example in which blockchain technology is used for traceability to the final consumer, but there is not a real use, in the sense that there is a Dutch company, Tony's chocolonely that have all the fair traced in blokchain, all, from the various countries from which they supply. They use an English technology as a system of data recording and use to communicate to their consumers this traceability as Tony's Chocolonely was born as a brand against the exploitation of slavery in plantations etc. etc.. However, there is a problem, and I can tell you this for sure because I deal with those who deal with this on a weekly basis: the final consumer does not open the code, and this is very rare, because it is not something they are interested in. However, this is true for chocolate, and this also comes from the characteristics of its supply chain: chocolate is a long supply chain, it is unknown to most consumers and they do not have any real knowledge about it. For example, another sector close to cocoa where blockchain has become massively established in Italy is in the case of coffee. This is because, where the supply chain is very short, as coffee is harvested, cleaned roasted and sold, it does not have many intermediate steps. Cocoa is a product that has an average shelf life of 5 years. From a cocoa bean you can obtain butter to make suppositories, coloring for cookies, a white milk covering, a croissant, a

piece of cake... it becomes many things, not just a bar. In fact, in countries like Italy and southern Europe, the bar is a minority transformation.

BASF

Tell me me something about the project

The theme of digital was more in-depth. Locally then the first completely dedicated department arrived in Italy and then the territorial marketing market. For the development of the theme, to date as a digital department we have solutions that arrive top-down then developed centrally and adapted to the local area and then in Italy we have also developed completely local solutions, are adapting then to other countries. Among these is the blockchain project "Riso Chiaro".

First of all, why did the company want to implement this project if for a reason of efficiency of operations, thus linked to the internal environment or for a transparency towards the customer?

Then our approach to blockchain is particular. It was born in the exploratory project of digital, to be an opportunity. The blockchain itself has so many opportunities, which you will know better than me, for efficiency, on the smart contracts side, we are looking at it from all different aspects. However, the first reason why we decided to apply this technology to the rice supply chain is the role of BASF in this supply chain. We have, as I said, also a part also of seeds on the rice front we have very close relationships with technicians, rice mills, winemakers, because we provide them the technology for seed books that have greater than the traditional ones we have an important and thick role in the rice supply chain because we provide the blockchain technology to give more transparency to this crop. On the one hand the reason was for us to enhance the role of BASF also in providing a tool that could go to tell the good practices of cultivation that include among other things our solutions the product books and

on the other hand use this role, we go to provide the rice farmer to provide a tool to manage this activity to then tell the rice mills rather than the end consumer. We do not sell directly to the farmer, we sell to retailers of the products, so they can be consortia, cooperatives which then resell to the farmer so we created this project to have a more direct relationship with the farmer, this solution that we pack and sell to the dealer who then resells it to the farmer, and we then also take care of the more technical aspect then also do assistance, both to the dealer and the rice farmer. There is part that is a management platform to allow the rice farmer to keep under control all the operations, the situation of all the activities that he has done, the other part is the transfer of all this information in blockchain to then reach the final consumer. On the one hand efficiency, in the sense that it allows the rice farmer to have a clear account of what he is doing, and for us it is an added value because by using new technologies we have a way to make them more aware of the good practices they have to adopt and on the other hand it is a value let's say of marketing, I would like not to say it, of communication because it is a tool that by giving clarity on all the steps that are carried out of processing gives the possibility to enhance the work of the farmer both at the rice mills so for example "Riso Scotti" to which this rice is delivered and to the final consumer in the case where the rice farmer produces, works and packages his own rice and on which he will put the QR code that will then give access to this information passed in blockchain.

From what I understand, you primarily work with business actors, so how does the implementation of blockchain impact the ecosystem on then relationship between farmer and rice provider?

In the case where the farmer gives the product in the rice mills allows to optimize the relationship between the two parties in the contractual regulation because at the time when the rice mill receives the rice but already has a certified history, tracked, then the ideal would be that it could recognize an extra value to this rice farmer and give a preference to the choice of this rice over others. Ideally, this step would also be regulated by smart contracts, which we would like to work on, but we are a third party so it becomes difficult.

If the rice mill wanted to decide to blockchain everything the rice farmer has internally at that point they would already have the downstream information available. On the end consumer the impact is more visible with the higher sales recognition.

Do you have any feedback on consumers, the company that used it what impact did it have? Do you have any feedback at the loyalty level? What kind of impact have you been able to measure and if you have been able to measure it.

This is the first year of sales so we will see the impact in this fall campaign. The kind of impact we expect will be more sales because we would like to channel it online by going to create a digital identity "Clear Rice," which is the name of the project, and we will give more visibility to the farms that are part of this project. We expect that by going to do sponsorship in their shops there will be a capitalization in terms of higher sales, of a higher price than the one they apply to their products.

For reasons of both sell out and profitability?

Exactly, yes. The goal is for greater profitability to date, precisely because we are still in the technology introduction phase. We also have other projects in mind on how to leverage blockchain further. You need to going to de-emphasize the technologies a little bit I don't know if you had a chance to look at the Polytechnic data in the smart Agrisud territory. It's very driven on the marketing side however there's a lot more to it.

I was a little bit trying to analyze that aspect, what were the reasons why companies were adopting them, what were the benefits of this technology towards the consumer on which the academic literature is not expressed.

Even in other areas of the food industry where blockchain technology has been adopted, the feedback is commercial, marketing where the consumer recognizes the higher value than others, because of the greater security they can receive from buying a product. that has a tracked history than others. The use of the QR code for us also has a function of intelligence because at the time when the consumer scans the QR code have access anonymously to a range of information from where it was scanned, if it is posted on social media, if it is spread as a story then give the farm a support, make him understand what are the descriptions words that can be more successful in sponsorship, so a lot of marketing here but also a lot of intelligence to collect inside more than those that can collect in the market sale or point of sale.

This is a feature that all solutions have or that only your blockchain solution has that allows you to trace the intelligence of the QR code data, where it was scanned from and

It depends on the service package that I know you want to do. We provide it as a service along with the data pass-through and the management platform. The peculiarity is the business model that compared to others is more complicated, with extra steps, compared to the direct passage between the technology provider and the farmer, here we are intermediaries with the idea of creating that system mentioned before.

Is your goal to create a value ecosystem where more players join your blockchain?

Our ecosystem to date includes us, the rice farmer in the two targets, the end consumer. We have also received requests from some rice mills that would like to join this same scheme. The problem is that to date we have received requests in the form of requests for exclusivity that we do not feel we want to support, we would like to maintain a potentially open system.

What do you think is the primary driver for why companies want to implement these technologies for a differentiation argument?

We have other very strong digital solutions resulting from this global acquisition, we would like to give more and more value to the management platform that we provide before the blockchain, however, preparatory to this, it is a service that we want to enrich and that is already a value for the farmer. The ability to tell a story, to give transparency to the data that are entered is an element of differentiation.

TruffleMarket

For what reasons have you implemented the blockchain, if for the traceability of processes and for a discourse of operations or for the relationship with the consumer and for both reasons what has weighed more for the choice of blockchain

We did the blockchain mainly to give an added value to the consumer, because the logistics that we adopt and all the operations are already automated and written in a programming language that does not need the blockchain to work. What the blockchain needs in order to work is the guarantee that the processes are carried out at the established times in the established ways and places. This gives the consumer extra assurance of what they are buying and that our processes are correct.

What are the main advantages for consumers of blockchain compared to a traditional traceability system?

The traditional traceability system for truffles is a system "that doesn't really believe in it," let me use that word. The traceability system for truffles, according to the Ministry's instructions, allows the truffle not to be traced, the blockchain, in our case it is an additional loyer that puts the truffle farmer in front of a series of obligations, at the moment he sells the truffle, which are higher than those required by law. Those obligations are not only written on blockchain but are also provided to the consumer. So we in choosing whether to adopt the traceability imposed by the Italian state or develop a new traceability system, we decided to adopt our own new and more stringent traceability system. This was due to a series of process requirements that code at some point began to use the blockchain and then we introduced a few more steps that are the notarization on blockchain, the whole process. In this way we closed thanks to the blockchain our traceability system. So we did not looked at other alternatives to certify provenance

The alternative was the agricultural tracking system which we do anyway, but we add extra controls to that one because the minimum traceability requirements for truffles are really minimal and not enough to meet the demand for authenticity in the global market.

Is this demand coming from the business or from customers?

More like the demand comes from the customers, without a shadow of a doubt. The business is interested in the authenticity of the product but is much more interested in having a quality product than an authentic product so what we see on truffle market is that the private customer buys from anyone as long as it is guaranteed. The restaurateur buys from the same truffle maker several times and it is a trend that has started and we are happy about it, it creates a relationship of trust.

Could you better explain this last statement?

Traffle market is organized by sellers, these have their own profile on the app. We have observed that business customers, who are mainly consumers or fur managers tend to make more purchases from the truffle marketer this is because when the batch has gone well the caterer creates a lighthouse, he has found in Italy a person who ships it while the individual

customer, the consumer buys more, the business customer creates this relationship with a seller.

So your biggest business is final users?

Yes.

How has blockchain impacted between you and consumers, at the level of trust? If you can declutter in what terms.

On the consumer side it's been a great success, a great response. The response has been seen in numbers we've had from the moment we introduced and made public the blockchain we've had a surge in users and usage of the app which has obviously been reflected in the number of sales as well. We are talking about a tenfold growth of the user base in a few weeks because in addition to having made news the blockchain so all food lovers knew they had found a way to buy truffles that was Italian and not the umpteenth site "comecompraretartufo.it". So from the cosumer's point of view the feedback was incredible. From the point of view of the truffle hunter I must admit that they did not understand what blockchian was.

So you think consumers rewarded this security choice because there was a blockchain behind it?

Yes it was one of the determining factors, the user friendliness played its part, the quality and price of the truffle played its part. But what made the user base increase tenfold in two weeks was the introduction of traceability on blockchain and of that there is no doubt.

What is your user base in terms of age?

I have this data. The biggest segment is the 40-year-olds, going up a lot more than down.

Is there an inherent knowledge of the technology and so people signed up because they knew the technology could provide this kind of certified tracking or do you think it came after that?

I absolutely believe that the audience that is on the app today knows what blockchain is and they downloaded the app because they know that blockchain is a reliable and secure traceability mechanism.

How has blockchain impacted the company's brand perfection if you've had any feedback? What aspects have impacted it the most?

Two years ago there were 42 companies in good standing selling truffles, this meant that 99.9% of truffles were sold off the books. Now there is a small change in broken given both by the possibility of having a flat rate regime, so it is estimated that about 10,000 people are paying taxes on the sale of truffles. Both experiences as truffle market there is this small change. Despite this the truffle market is a world that knows no laws, taxes or rules. To see that a group, an association of truffle hunters has come together to ensure an Italian product with cutting-edge technological tools and paying taxes, because simpler than that you can not do, this was a giant blow. By blow I mean that it broke the news, the newspapers.

Did it have a big company awareness impact?

By using blockchain we consequently have all the saved data of transactions and saved on blockchain so you can't change the amounts and therefore those who sell on truffle market pay taxes. The Ministry couldn't find the tools so the truffle marketer was obliged to track the product at the time of sale and pay taxes on it. Truffle market allows those two things. To get back to the question, in terms of awareness, we have sold truffles to the Senate, to many people, we have mostly received excellent feedback from the press. Many truffle hunters, used to black transactions and unheard of taxes, were not enthusiastic about the idea of traceability, because in my opinion it is the classic resistance to innovation. It is very clear that a line has been created in the truffle world, and not only by truffle markets, but from day one when truffle hunters give themselves traceability tools superior to those of the Ministry, and this marks a turning point.

Why does it mark a turning point?

Because thanks to blockchain we can give ourselves tools that are more rigid and functional than we can give ourselves thanks to the law. Consumers have a gain from traceability, truffle hunters have a burden, but this effort of guarantee and authenticity for the product is required in today's world. Truffle hunters obviously have an extra burden but for consumers it becomes something more, a need.

So it has been a factor of differentiation with respect to the offer that there was on the market and in what terms?

A lot of fraud is consumed on truffles. If you go and look at the websites of the biggest truffle sellers they tell you the fairy tale of grandpa going under the lime tree while we are talking about truffle empires with thousands of truffle makers who every day also with unfair practices supply these companies. Blockchain allows you to skip that old-fashioned storytelling and connect the truffle farmer with the consumer. So it has been a differentiating factor, both the truffle farmer who creates a value given by the guarantee on blockchain in the same way as an organic brand, d.o.p. creates value on other types of goods, the certification on blockchain of the truffle creates value.

It creates an ecosystem of value in the sense that on the one hand there are consumers who want to have a board for a security on the other hand the most innovative truffle makers who want to abandon the black but want to create an added value to what is the product.

It couldn't be summed up better than this. For truffle hunters this is a burden and it is not immediate, so you said it right they need to be more innovative, more awake.

From the data you have what is the level of loyalty for your company, do those who use it continue to use it?

We can skip the question because the data takes a few days.

Let's comment on it on a qualitative level. How was the retention towards the brand, then towards the truffle market company? Have they come back did you get any feedback of satisfied?

Those who had already made purchases before the introduction of the blockchain made purchases immediately after its introduction to try in my opinion and they were happy because they did them again. The new customers that came in when we announced that we had implemented blockchain technology only the first few purchases, only a few made recurring acquisitions let's say. Now actually opens the season of white truffle that is the most sought after, the most sought after, the season opens on September 21 we will open on October 4 to avoid to avoid selling truffle fiorone, (a technicality). To ensure a better product we will open in October and evaluate on an international scale the effect of blockchain technology.

So until now you can't make a before-after comparison, you didn't have it before you intrdootta it so you still bdon't have data available.

We are born with blockchain, before we each sold individually to our customers and there was no tax.

On an investment level, how much did it cost to implement the blockchain if you think it pays off? Qualitative considerations on return on investment.

We spent virtually nothing to implement the blockchain, we just downloaded the Ethereum documentation and implemented writing to blockchain inside our code. It wasn't easy at all but we didn't have any costs associated, we had an operational cost for writing to blockchain that exists but it's low so we don't have any investment to write off, we read the documentation, we used it and it worked.

Did it impact the perceived quality of the products?

Absolutely. What I was saying by added value. A carrot with a stamp is worth a lot more than a carrot without a stamp. In this economy of value, having information associated with the product increases the value of the product. In fact, there are companies that specialize in selling information that increases the value of products.

Has this also increased the price at which you are able to sell your truffles? Has it impacted profitability?

Exactly. It has impacted both because we sell to the end customer without going through intermediaries anymore, and because a blockchain-certified truffle is worth more than a truffle that doesn't have blockchain certification.

Are customers willing to pay a price premium for this type of certification?

Yes. The economics of truffle market all revolve around that. I'd rather buy it from a truffle farmer who lives in this municipality and provides me with blockchain traceability with NFT tokens than buy a truffle I don't know about from a store.

T he blockchain has given a positive sprint to our band, recognized by all national and international media and we are extremely pleased to have used blockchain technology for traceability. We have received praise from the Ministry of Agriculture for this choice and for the ability to apply an innovative technology to a stagnant and entrenched sector. It has increased both the value of our company and our product incredibly. If truffle market had not

implemented blockchain technology probably no one would know truffle market exists, or rather we would only have a small circle of customers.

So the consumer experience towards your product has changed.

Yes, because I order a product with more security and more guarantee and I receive with the product a totem on blockchain that is the equivalent of the Italian truffle stamp only that it is applied to 2021.

Have all the customers on truffle market rewarded this choice?

Absolutely, yes. Above all, they have been willing to pay more to buy truffles on truffle market than on other channels.