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The impact of blockchain technology on two-sided platforms dynamics and the rise of blockchain-enabled marketplaces

TESI DI LAUREA MAGISTRALE IN MANAGEMENT ENGINEERING - INGEGNERIA GESTIONALE

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ABSTRACT

The adoption of *platform-based business models*, in the modern economy, has been growing continuously and became tremendously successful in the last decade. Also, the huge amount of market value conquered by colossal platform companies (*Airbnb, Uber, Amazon*), witnesses the huge potential of such disruptive BM. Platform-based business models has challenged established companies and industry dynamics in different sectors. Digital platform companies, by leveraging network effects and acting as orchestrators of external resources, quickly disrupted traditional linear value chain-based businesses. Digital players were able to create global marketplaces where individuals, products and services could be matched more effectively than ever before. However, it seems that something is changing in the competitive arena of digital platforms. New *digital technologies* are revolutionizing the concepts of how platforms are defined and used by challenging their business models in the same way platforms did with traditional value chain model. In particular, *blockchain* has gained huge interest among researchers and practitioners due to its potential characteristics of enabling new kind of business model. Specifically, relying on its *disintermediation* objective when applied to transactions, blockchain technology gives the possibility to *decentralized marketplaces* to emerge redefining dynamics and roles of traditional marketplaces operators such as Amazon and eBay. Whereas some established players will be able to use this opportunity to further scale their operations, others will be challenged by new entrants proposing entirely new approaches to *value creation* and *value capture*. This thesis investigates the transformation brought by blockchain technology in the model of *two-sided platforms* and subsequently analyzes the applicability of the technology in marketplaces describing also the model of *decentralized marketplaces*. Furthermore, *the role of intermediaries*, intended as marketplace operators (or platform providers), will be investigated focusing on new ways they may still add value to the network.

ESTRATTO

L'utilizzo di modelli di business basati su piattaforme è in continua crescita e ha riscosso un enorme successo nell'ultimo decennio. L'imponente valore di mercato conquistato dalle grandi *Platform Companies* (Airbnb, Uber, Amazon), testimonia l'enorme potenziale di questo efficace modello di business. Queste digital *Platform Companies*, sfruttando gli effetti positivi delle esternalità di rete e agendo come orchestratori di risorse esterne, hanno rapidamente sconvolto le tradizionali attività basate su una catena del valore lineare. Inoltre, sono state in grado di creare mercati globali in cui individui, prodotti e servizi possono incontrarsi in modo estremamente efficace e veloce. Tuttavia, qualcosa sta cambiando nel contesto delle piattaforme digitali. Le nuove tecnologie digitali stanno rivoluzionando le modalità in cui le piattaforme vengono definite ed utilizzate, mettendo in discussione i loro modelli di business. In particolare, tra le ultime tecnologie, la blockchain ha suscitato grande interesse tra i ricercatori e gli operatori del settore per le sue capacità di definire nuovi modelli di business. Nello specifico, avendo tra le sue proprietà la disintermediazione delle transazioni, la tecnologia blockchain dà la possibilità ai *marketplace decentralizzati* di emergere ridefinendo le dinamiche e i ruoli degli operatori tradizionali, come Amazon ed eBay. Mentre alcuni operatori saranno in grado di sfruttare questa opportunità per scalare ulteriormente il loro business, altri saranno messi in discussione da nuovi attori che propongono modelli innovativi di creazione e acquisizione del valore. Questa tesi indaga la trasformazione apportata dalla tecnologia blockchain nel modello delle piattaforme *two-sided* e successivamente analizza la possibilità di applicare questa tecnologia nei marketplaces, introducendo il modello dei "*marketplace decentralizzati*". Inoltre, viene indagato il ruolo degli intermediari, intesi come gestori del marketplace (o gestori della piattaforma), illustrando nuove modalità con cui essi possono ancora apportare valore all'intera piattaforma.

1 INTRODUCTION

Colossal platform-based companies like Uber, Amazon and Airbnb have disrupted several sectors in recent years, making the **platform economy** definitely emerge. By playing the role of intermediaries and leveraging **network effects** these companies have continuously improved and rapidly scaled their business models thus gaining tremendous market value and growing market share. While companies based on traditional business models are still trying to figure out how to resist to the disruption led by platform companies, a new technology has already knocked at the door with the potential to generate a significant impact on platform-based business models. This disruptive technology is **blockchain**.

Blockchain technology is general purpose technology, a distributed database of transactions, with the promises to re-define the ways in which users interact and exchange value, information, products, and services. By removing *middlemen* and equally distributing the value created among platform users, this technology is expected to inaugurate a new economic age, enabling platform economy to advance. Due to its technological properties, blockchain allows for the implementation of the so-called decentralized platform-based business models, which enable instantly P2P interactions between users potentially cutting out any intermediary.

Even though most of the famous example of decentralized platforms, such as *OpenBazaar* marketplace, have not been able to provide a complete decentralization yet, they aspire to develop decentralized business models as an alternative to the monopolistic market dominance of centralized platforms.

The objective of this thesis is to provide an overview of the innovations that blockchain technology may bring to platforms, particularly in *two-sided marketplaces*, and how this technology can reshape the key **dynamics** and **characteristics** of these successful business models. Furthermore, this Report aims to clarify the subtle and complex notion of decentralized markets, in order to comprehend the differences and possible benefits when compared to traditional centralized models. This thesis also attempts to determine whether a decentralized framework is a *threat* or an *opportunity* for **marketplace operators**, as well as what is the factor that keeps the entire network together despite the possibility, for users, to completely disintermediate from platform owners.

The analysis as to be intended as a *narrative literature review*. This approach is mainly used to describe and evaluate current literature without focusing on methodological details, and it fosters exploratory research by enabling the creation of a solid foundation for future investigation. The main difference with a traditional literature review, is that the selection criteria as well as the methods of extraction and synthesis of the data, are not explicitly defined.

The report is structured as follows. The **second chapter** introduce *platform economy* and define *two-sided platforms*. In **chapter 3**, *blockchain technology* and its main properties are illustrated. **Chapter 4** analyses how blockchain impact the elements of *business model*, referring to framework introduced by Osterwalder in 2004 (Osterwalder, 2004). In **chapter 5**, the innovations brought by blockchain in the models of two-sided platforms are discussed. In **chapter 6**, the concept of *decentralized marketplaces* is introduced and subsequently two case studies, respectively *Open Bazaar* and *Origami Network*, are presented. The second part of the chapter analyses risk and opportunities linked with these new models from the point of view of market operators. Finally, in **chapter 7**, conclusions and additional insights are given.

1.1. METHODOLOGY

The research approach used to conduct this thesis is the *secondary research approach*. It's an approach that involves selecting and reorganizing existing data and findings that can be sourced from the internet as *conference papers*, *academic books*, *scientific editorials*, *business articles* and *reviews* that look at prior literature, business cases, or introduce novelties in the scientific literature. The aim of this approach is to study the *state of art* of the existing literature from previous researches and apply this information to a specific research context.

There are *five* key *steps* to conduct a secondary research effectively and efficiently: 1) *Identify and define the research topic* 2) *Find research and existing data sources* 3) *Begin searching and collecting the existing data* 4) *Combine the data and compare the results* 5) *Analyze your data and explore further.*

Applied to this thesis, once the topic was identified, information had been gathered through citation *database*, advanced search engines and networking sites for academics. *Scopus* and *ResearchGate* have been the most widely used sources. To carry out the third step of this approach and focus on the selected topic, some key words have been used. Among them, the most used are: "*Two-sided platforms*", "*Platform Economy*", "*Blockchain properties*", "*Decentralized marketplaces*", "*Blockchain marketplaces*", "*Network effects*", "*Blockchain-enabled platforms*", "*Blockchain advantages*", "*Token effects*", "*Tokenization*", "*Disintermediation in marketplaces*", "*Blockchain Business Models*", "*Platform Value creation*", "*Platform Value sharing*".

As a result of the very first search, more than 100 documents came out. These were subsequently skimmed by applying some filters. More specifically, only documents from 2017 onwards were considered, because the research topic has begun to be effectively investigated only after this year. Then, also a preferred subject area was applied, in particular "*Business, management and Accounting*". The remaining articles have been read and only if considered useful to reach the research objectives of the thesis, they were considered, otherwise they were discarded. As a result of this process, 50 articles remained. Then, a fourth step was carried out by clustering documents with similar specific topic. During the last step, the findings from papers of each cluster were analyzed and summed up into brief takeaways. Furthermore, collateral researches on the web have been conducted in order to gain the necessary knowledge to better understand the topic investigated due to its huge complexity.

The two discussed case studies, respectively *Open Bazaar* and *Origami Network*, have been selected following this simple rationale: the first was selected to provide an example of failure in the application of the "decentralized marketplace" model; while the second has been chosen as an example of success and for its fitting aspects to the findings emerged from the analysis.

For the discussion of the two case studies, secondary sources were again considered: both scientific reviews and online business articles. To discuss Open bazaar case study, the main sources have been the analysis provided by Mik, (2019) and the interview conducted by *Yahoo!* to the ex-CEO Brian Hoffman. While for Origami Network case study, it has been mainly considered the white paper of the project and the work of Mik (2019).

2 CONCEPT OF PLATFORM

This chapter is aimed at introducing the theoretical background on the topics of platforms and the key characteristics and dynamics that define the **platform economy**. This illustration also allows a better understanding of these particular and successful business models thus laying the ground for the subsequent discussions.

Traditional industries have been shaken up by platform-based business models thus giving rise to the platform economy. Companies like Alibaba, Amazon, Uber, and Airbnb built online marketplaces where people can sell their goods and services. The platform itself acts as a **middleman** (Parker et al., 2016), coordinating the interactions between users (Caillaud & Jullien, 2003; Rochet & Tirole, 2003) without even owning the products being sold. Since there are no production and storage costs, platform-based business models (PBM) were able to grow without making additional investments. This made platform BM more cost-effective and flexible representing a tremendous advantage over traditional business models like traditional retail stores (possibility to offer a greater range of products). Also, these platform models quickly gained users because they create and leverage a wide range of **network effects** (Eisenmann et al., 2011; Parker et al., 2016) which makes them a serious threat to established companies, even market leaders.

2.1. PLATFORM ECONOMY

Today, platform-based ecosystems are everywhere. Firms are changing how they do business to deal with globalization and more competition on the market. Increasing numbers of businesses are finding digital platforms to be an ideal place to reorganize or start from scratch. Martin Kenney and John Zysman (2016) called this a new type of economy the "*platform economy*." Using external resources and competences, these new business models provide a virtual space where diverse groups of people may connect and engage. The Internet and other *IT technologies* have changed a lot in the last few decades, and this has helped the platform economy grow quickly and in many places. In particular, the new algorithms that can be computed and Cloud Computing were important parts of this change. Indeed, the Cloud enables companies to employ distant servers to perform numerous functions, such as storage, processing, security, and analytics. On the other hand, Computed algorithms could be used to analysed information and extrapolate value from data to support different business processes. When these algorithms were moved to the Cloud, they became the basis for the creation of *digital platforms*.

Figure 1. Overview of the main platform players per sector

Because of this, digital technologies become easily accessible and affordable for organization organizations. These tools became the foundation on which global markets and ecosystems based on platforms could be built. Today, there's a wide range of platforms that are changing the way firms operate or even creating entirely new markets, which are digital by nature. For instance, because of big companies like Amazon and eBay, many commerce places have been transferred online, allowing individuals to exchange information and *directly* trade their products and services. An example of this process is represented by Google and Facebook. They are digital platforms offering social media matching services, but they also make it possible for other platforms to run their own businesses on top of them. Then there are platforms like Uber, Deliveroo, and Airbnb, which have helped start new businesses (e.g., the sharing economy, food delivery etc.). All of these digital platforms, based on different BMs, have built their own *ecosystems* and created new ways to work together and compete, which has changed our economy and society in a big way.

Before looking at the dynamics that researchers have identified in platform-based markets over the past few decades, it's crucial to figure out what a platform is. However, it's not easy to come up with a unique way to explain what a digital platform is. There could be a lot of reasons for this. For example, the concept of "platform" is frequently misused to talk about different business models. In a world where everything is digital, every business that provide a service to its customers online is often defined as a "digital platforms." Also, most of the new companies that have become big in the last few years are usually called platforms. Therefore, since the term "platform" can have many different meanings and misuses, it's important to look at it from a "context" point of view. For instance, the word "*platform*" has also been used in the manufacturing context to describe the physical architecture that makes it possible for a company, the production and assembling of products.

As a result, there may be some misunderstanding about what a platform actually is, given that the same concept is linked to many business models. This is why, over time, researchers have offered numerous interpretations of the term "platform". In the context of this report, I will introduce the concept of **two-sided model** since it's meaningful for the understanding of the following chapters. However, before, I will give a brief overview of the **concept of platform** and its evolution over time.

2.2. THE ADVENT OF PLATFORMS AND KEY CHARACTERISTICS

The global economy has seen a variety of trends emerge during the past several decades. The raising of platform businesses is one of the most significant among them. Looking at the numbers that describe this phenomenon, it's possible to figure out the magnitude of this trend. The platform industry is worth $4.3 trillion and has millions of direct workers indirect workers and it is expected to keep growing over the next few years (Evans & Gawer, 2016).

Since platforms have made their way into so many different business models worldwide, they're becoming *ubiquitous* and are now found in a wide range of different sectors, including as financial services, e-commerce, energy, healthcare, and mobile technology. As the concept of omnipresence emerges in literature, some experts claim that we are now living in the *age of the platform*, and that all businesses, not just technological ones, must think of themselves as platforms in order to function and work (Altman & Tushman, 2017).

These platform models address and satisfy two or more diverse client groups by creating an environment where one side needs the other for various reasons. Platforms allow consumers connect in various ways, resulting in value that they would not be able to acquire without the platform's function (Evans & Noel, 2005). In this context, the **platform owner** serves as a *middleman* who is accountable for the platform's growth and expansion. Moreover, since the product/service that the platform owner gives to his or her customers are represented by the platform itself and its functionalities, his role is also to make sure that all platform users can get access to these products and use their features.

In reality, platforms have been a part of our life for a long time. Indeed, considering platforms as a means to match together two or more groups of participants, events like *exhibitions* and *trade fairs*, which have existed from ancient times, may be seen as *physical platforms* that have enabled the connection of two diverse groups of people and the satisfaction of their demands. More specifically, merchants can access a large group of potential buyers while people can access a huge offer of many different items. These two groups of people connect owing to the places that act as an "*aggregator*" thus creating a *two-sided network*. Today, instead, we are rather dealing with digital platforms that are increasingly reducing their physical components wherever feasible.

Platforms have become increasingly important in terms of roles in today's economy. With the advent of the Internet and its ability to quickly link individuals together, their deployment has grown in importance. Sixty percent of the world's most valuable corporations made more than half of their income through **two-sided platforms** in 2007. (Eisenmann, Parker & Van Alstyne, 2011).

A platform is an architecture built on well-designed value propositions and an infrastructure that relies on the interactions of network users. It also includes a set of rules that include the protocols, rights, and pricing terms that govern transactions. To compete or even beat traditional BMs, platforms need to get a critical mass of users to trigger positive **network effects**.

In general, most platforms show two kinds of network effects or network externalities: **same-side** or direct *network effect* and **cross-side** or indirect *network effects*. The former refers to the fact that an increase in the number of users on one side could increase (or decrease) the value perceived by users on the same side. The latter refers to the fact that an increase in the number of users on one side could increase (or decrease) the value perceived by users on the other side.

In this way, "the value to customers on one side of a platform typically increases with the number of participating customers on another side" (Hagiu, 2014). Creating NWEs is thus a critical aspect in the success or failure of any platform. As a result, the development of NWE is sometimes referred to as a *double-edged sword* since it generates high market entry barriers for rival platforms while also being difficult to actualize due to the so-called *chicken-and-egg dilemma*. However, since NWEs strengthen competition between platforms, those can result into a market concentration up to the "*winner takes all*" situation where one platform dominates the whole market. The market would then be served by one platform, with the other platforms being kicked out due to their inability to attain critical mass anymore (Evans & Schmalensee, 2008).

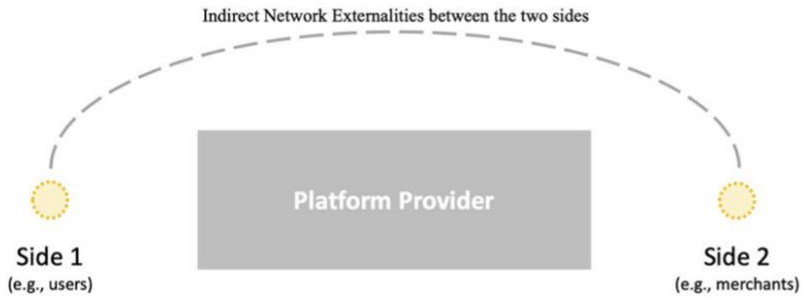

Figure 2. Two-sided platform and network effects

Among the characteristics that define platform there's the orchestration of specific resources and capabilities made by the platform owner: 1) *Platform technology*; 2) *Partners*; 3) *Members of the community*; 4) *Users' data*. They are all resources that platform owners may use to manage their business, but academics have also highlighted *three crucial competencies* that are required to withstand the competition and allow platform to expand: a) *Community's assets management*; b) *Technological improvement*; c) *User engagement*.

2.3. TWO-SIDED PLATFORMS

A new notion of platform, cantered on two-sided marketplaces, was introduced into 2000s economic theory: **two-sided platforms**. These are defined as markets that allow for the exchange of value between diverse group of customers (Rysman, 2009). The introduction of this novel concept of platform split platform literature in two different *streams*: I) the *engineering design stream*, which focused on internal and external platforms that enable firms create modular product innovation; II) the *economics* *stream*, which focused on how platforms as markets, can reduce market frictions between two sides.

2.3.1. DEFINITON

Among the various definition of two-sided platforms given by researchers, there's the one introduced by Rochet and Tirole (2006). According to what they claimed, **two-sided platforms** are *markets* in which one (or more) platforms *enables* end-*users* to communicate and *interact* with one another, and try to get two (or many) sides on board by *appropriately charging* each side. The easiest common example of two-sided platforms is the credit card system, where two sides, card holders and merchants, are "linked" into an interaction through firms like Mastercard and Visa that act as platforms.

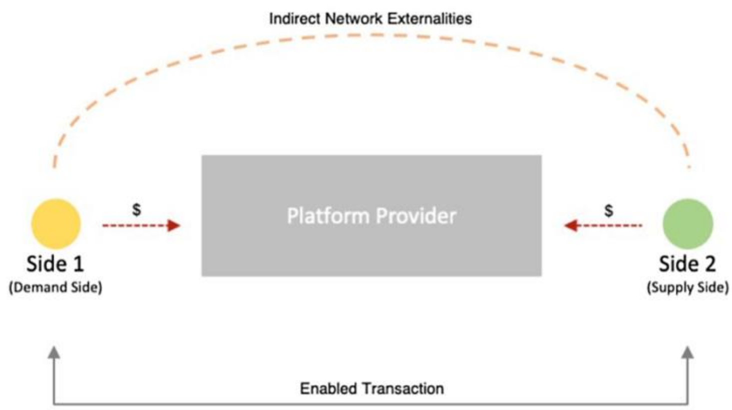

Figure 3. Two-sided platform framework

In 2003, Evans pointed out some necessary additional features that characterize these platforms: 1) the presence of *two* (or more) different ***groups of users*** that benefit from each other's interaction in the platform 2) These sides are linked through *indirect* ***network externalities***. 3) the presence of an ***intermediary***, the platform provider, that facilitates the transaction between the sides by delivering a proper value proposition to both (multiple) sides and that internalize the existing network externalities.

However, following these definitions, every form of market can be thought as a two-sided since there are always both buyers and sellers to match.

According to Hagiu (2007) even though there are digital and physical middlemen in all markets who connect sellers and buyers, not all of them can be intended as two-sided platforms.

Indeed, he distinguishes between two types of intermediaries: *merchants* and *platforms*. The former ones just resell products and goods to buyers after buying them from suppliers. The latter ones, instead, create an *ecosystem* to match buyers and sellers. Merchants have control over transactions' variables in terms of price, quantities etc.. while platforms, since they do not own products directly, leave sellers full control about transactions features.

In terms of economic sustainability, the *value capture* of the BM of two-sided platforms is usually based on the transaction fees that may be charged to one or both sides. However, the involvement of potential non-transactional sides that subsidize the system (e.g., advertisers) may lead to platforms where *none* of the sides is charged (Filistrucchi et al., 2014; Trabucchi et al., 2017).

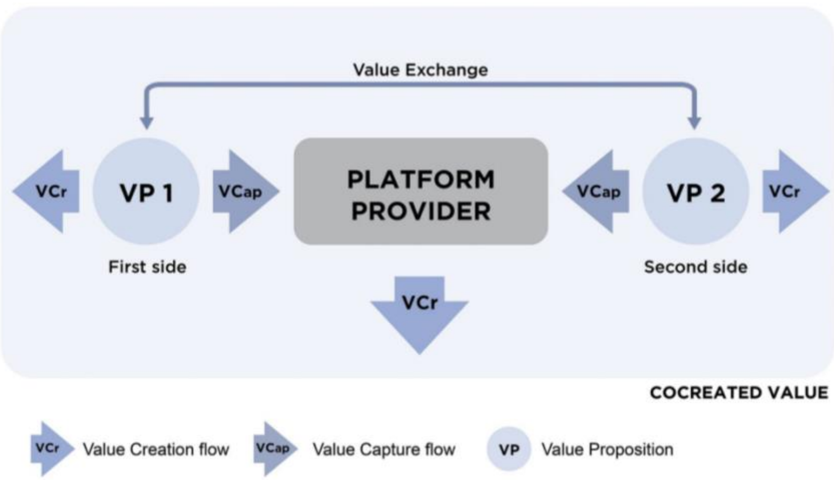

Figure 4. Value exchange representation for two-sided platforms.

The elements that define the structure and function of a two-sided platform are (Parker et al, 2016):

- **Platform owner**, that owns the platform and is in charge for developing and ensuring platform functioning.
- **Participants**, that are the sides matched by the platform. These are then divided in a *producer* (who creates value) and a *consumer* side (who consumes value). Many platforms enable users to move between roles, allowing them to simultaneously play the role of host and guest. For example, on YouTube, users can either be a content creator and also "consume" contents created by others. This concept, allow to make a consideration upon value creation in these BM: in two-sided platform, part of the value creation in outsourced since there's one side (suppliers) that act as supplier for the other.

  In particular type of platforms, such as non-transactional, there could be also another participant, the non-transactional side (such advertisers) that do not directly interact with the two sides but enjoy the presence of them (since are its potential end-users) and contribute to sustain the platform BM.
- **Value unit**, that is the unit of exchange between sides. Depending on the different stages of the interaction of the sides, it could be a piece of information, a real product/service or the money or currency that consumers pay to producers.
- The **filter**, that is the technological "environment" that allows buyers and sellers to properly trade by making smooth the whole exchange process. This "filter" allows the platform provider to gather a large amount and variety of data, enabling *data-driven strategies* for capturing value.

2.3.2. TYPES OF TWO-SIDED PLATFORMS

As there are several definitions of two-sided platforms proposed by researchers, there exists also different types of them. Among them, the main two categorization introduced by Filistrucchi and colleagues (2014), are: **Transactional** and **Non-Transactional** platforms. The distinction is based on the presence of observable transactions between the two sides. Transactional platforms entail a direct transaction between the sides; while non-transactional ones offer their product/service to one group and try to *monetize* the value embedded in the first side by selling access to that group to a second one.

Marketplaces are the easiest representation of **transactional platforms**. Marketplaces make it possible for a supply-side to meet and transact with a demand-side. The value proposition offered to users and the value unit object of the transaction are very different between marketplaces. Taüscher and Laudien (2017) grouped the business models of transactional platforms into six categories based on these two factors. There are business models that make it easy for people to buy and sell physical products leveraging a value proposition aimed to provide efficiency and cost savings (efficient product transactions) or social community functionalities (product aficionados). Others offer new sales channels for service providers (on-demand offline services) or even a revolutionized value proposition for the supply side (peer-to-peer offline services).

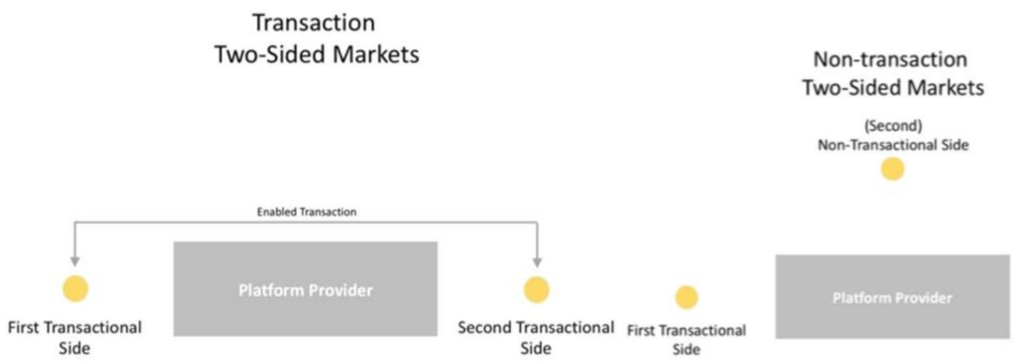

Figure 5. Representation of transactional (*left*) and non-transactional platforms (*right*)

Newspapers instead, are classic examples of "**non-transactional**" platform, where advertisers cover great part of the value capturing by paying with the aim of reaching potential end-user populating the platform (readers). These platforms offer the product or service for free to the readers, that represent the side with higher demand elasticity. It is through this price reduction that new readers are attracted to the platform, thus increasing the value for the other side. Increasing demand in the complementary market (advertisers) can offset the expenditures in the subsidized one (readers), according to Parker and Van Alstyne (2000).

2.3.3. NETWORK EFFECTS AS POTENTIAL LOCK-IN EFFECT

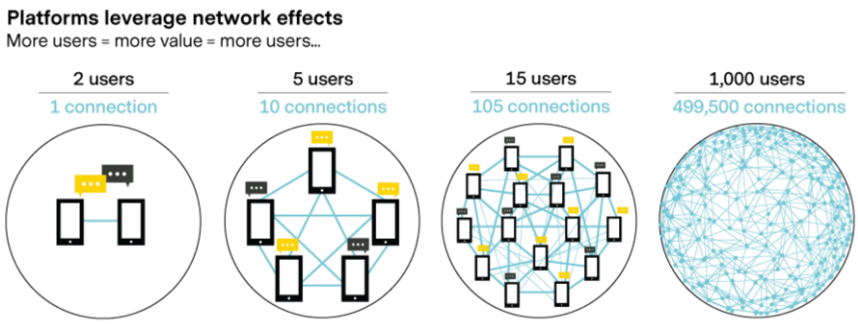

Figure 6. Representation of network effects on Platform ecosystem

Both transactional and non-transactional platforms present "direct" and "indirect" network effects between the sides of the platform. **Direct network effects** happen when the platform's value perceived by a user, changes depending on how many other users are on the same side. All platform BMs are affected by this effect. For instance, professionals are more likely to get on board of *LinkedIn* platform if there's a huge number of other professionals already onboard, otherwise they wouldn't see the potential value. As a consequence, more professional join, the service provided becomes more and more valuable thus creating a positive loop.

Indirect network externalities or *cross-side effects* occur when the benefit perceived by users in one group and their decision to join the platform depends on the number of other users in the other side and vice versa. The classic example is gamers and game developers in console industry. The more are the users playing a particular console, the more are the incentives for developers to develop games for the console. Indirect network effects are more significant when the needs of the two sides are already mutual and interdependent. However, this is not true for platforms that don't involve direct transactions. For example, a newspaper connects readers and advertising companies without any transactions. There are definitely some indirect network effects that are good for advertisers since more people buy and read the newspaper, the more is the audience for their adv. For readers is not the same, though. They do not need ads, so the fact that there are more advertising companies on the other side doesn't help them in any way.

These network effects establish a *self-reinforcing loop* of adoption for the platform called "bandwagon effect", which may kick out potential competitors and lead to a "**winner-take-all**" situation (Eisenmann et al., 2006). Indeed, network externalities are more than just a way to make business grow. They not only bring new users to a platform, but they also keep them there. This phenomena is called "***lock-in***" *Effect*. Network effects let platforms improve their market position and value offerings to a level that competitors can't reach thus creating a powerful new type of entry barrier. As a result of these dynamics, in markets populated by platforms, where there are often self-reinforcing loops and the winner takes all risk, there is often a strong competition between competitors to reach the so called "critical mass."

2.3.4. CRITICAL MASS & WINNER-TAKE-ALL OUTCOMES

Rohlfs (1974) defines **critical mass** as the *minimal volume of users* that join the network and are satisfied with this choice. The **bandwagon effect** will be triggered by any number that is more than that amount, while any smaller amount than that will cause the network to fail. The bandwagon effect, which is caused by reaching a critical mass, helps successful platforms grow quickly in context where they can grow without limits. Moreover, the chance of rapidly scaling up is powered by digital technologies and the **zero marginal-cost structure** brought by the shift of platform BM from the concept of owning resources to the concept of access and orchestrating resources. However, even though network effects are that powerful, a winner-take-all effect does not always emerge in two-sided platforms. Indeed, according to Evans et al (2010), It is not that easy for platforms to reach the critical mass and start the bandwagon effect (as in the case of *multihoming*): actually, it is the most difficult obstacle to overcome for platform businesses during their first phases. Especially due to the presence of the so called "*chicken-and-eggs*" problem.

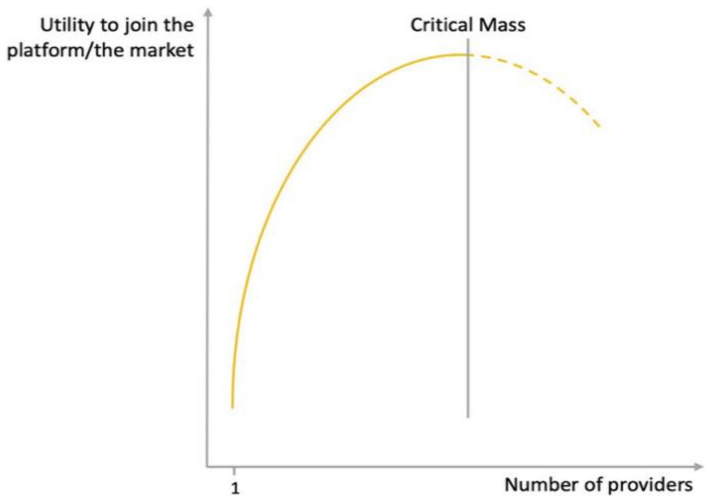

Figure 7. Curve representing critical mass volume

2.3.5. THE CHICKEN-AND-EGG DILEMMA

The **chicken-and-eggs** *dilemma*, introduced by Caillaud and Jullien (2003), refers to the fact that since the value of a platform to customers is directly related to the number of users on the other side, there is often a stall in the *launch* phase of a platform, when users on the first side won't join until they see a consistent number of users on the other side, and vice versa. This usually happens in transactional platforms because in the case of non-transactional ones, even without the other side (advertisers), users may benefit from the product or service provided by the platform (Instagram, facebook, linkedin).

As a consequence, compared to traditional pipeline models, in platform BM, the definition of the *value proposition* become much more complex. Indeed, it must be robust and specific for each side and has to be accompanied with the creation of a trustworthy environment.

2.4. REAL-WORLD EXAMPLES OF TWO-SIDED PLATFORMS

All the definitions illustrated so far, theoretically explain what the two-sided market is from different perspectives and which kind of features it has. However, the easiest way to figure out the *dynamics* and the strategies that these platforms use to thrive in the market, is by analyzing real-life **examples**.

Uber and *Airbnb* are two companies that are considered the most relevant example of how successful could be to properly design a BM based on two-sided platforms. As a result of their rapid expansion, both firms have become two of the most valuable unicorns as well as two of the most discussed case studies in the world o platforms.

Uber operates in the *mobility industry*, playing the role of a matchmaker between passengers and drivers. Uber's original value proposition was to allow consumers to "order" the nearest cab using a smartphone app and go anywhere in the city fast and effortlessly. The concept was turned into a digital platform that allowed independent self-employed drivers with luxury black vehicles, to transport customers in return for monetary compensation. Uber established value in this arrangement by simply allowing customers, who are often professionals, to discover a convenient and pleasant alternative to traditional taxi trips that are usually more expensive, and frequently of poor quality.

Airbnb, instead, operates in the *accommodation industry*, matching houses owners offering a place to stay and people looking for an accommodation. Airbnb's original value proposition was to link low-cost tourists with people who wanted to supplement their income by renting rooms in their home, generating value for both parties while putting cash away from high-priced hotels into the pockets of “amateur” renters. The platform has then grown in popularity, expanding on its original “affordable travels” premise to include the concept of traveling to foster a sense of "belonging" to the local community.

Even if they operate in different industries, both platforms developed their businesses on the same basic *concept*: acting as *intermediaries* between a supply and a demand side, allowing users willing to *monetize* their “*idle*” resources (houses, cars) for the benefits of other users that were seeking alternative solutions to the traditional marketplaces. The results have been incredible. Despite not owning a single car and depending on roughly 1 million drivers, Uber had conquered a market cap of *$60–70 billion*, whereas, its main competitor, Hertz had a market cap of *$7 billion* with 350 thousand vehicles. Airbnb, as well, obtained comparable results becoming the second most-valuable startup in the US.

More specifically, neither Airbnb and Uber own the assets necessary to perform their businesses. Their *value-creating activity* is linking users with some needs with users who can satisfy those needs, thus creating value together and at the same time, catching back some of this value by charging a transaction fee. Both platforms have evolved through time in terms of how value is created, delivered, and captured. These evolutions have involved also other stakeholders with a different role compared to the one of a simple users, thus enhancing and boosting the activity of intermediary and the value-creating process.

2.5. LINEAR VALUE CHAIN VS PLATFORM MODEL

Platform's models had a significant impact not only on the way the market is set up, but also on the linear value chain. Making a comparison with **traditional pipeline** businesses, platforms present completely new business models. Indeed, the former buy inputs from suppliers, transform them into finished products (output) and attract customers to sell their goods or services. The entire manufacturing industry is based on a pipe model, television and radio are pipes that produce and send information to us.

On the other hand, platforms act as **matchmakers** attracting two or more types of customers and enabling direct interactions between them (Evans and Schmalensee, 2016). The sides, that joined the platform represent the most significant input, for which multiple value propositions must be designed. Platforms, unlike pipelines, don't only create and push products out. They let people the generate and consume *value*; indeed, users can act as producer and create value on the platform for other users that act as consumers. To keep the example mentioned before, a typical case is TV channels vs YouTube.

This change in the generation of value represents the most important consequence of shift from traditional pipes to platform models. Indeed, while *value chain* models are characterized by a single and *linear* flow of value, platforms can leverage different sources of value from which it can be then capture. For instance, as illustrated before, int the case of Youtube, the value can be generated by the users (e.g content creators).

The main differences between traditional linear model and platform model can be categorized as follow:

- Regarding **user acquisition**, that is particularly easy for pipes. Indeed, they attract users in and then persuade them to make a purchase. In the same way that a retail business focuses on attracting customers and converting them in transaction.

In contrast, platforms since usually do not have value at the very first stages, and so suffer from a chicken and eggs problem (as explained before). More specifically, platform have two key challenges: solving the *chicken and egg problem* and ensuring that producers (from one side) actually create value for the other side. Moreover, platforms need to build a trustworthy environment where both sides can trust each other and the platform provider at the same time.

- Regarding the **product design process**, pipes usually conceive new product while having a single specific type of consumer in mind. A travel agency, for instance, create a product to satisfy only the need of travellers.

  Platform, instead, have to design specific *value proposition* for two sides, buyers and sellers, each with different needs and requests. This make their job tougher. Building YouTube, requires to build tools for producers (e.g. video hosting on YouTube) as well as for consumers (e.g. video viewing, voting etc.).

- Regarding **monetization**, it is really straightforward for a pipe to set a *pricing strategy* because the final customer is typically the one consuming value created by the business.

  In platform business, instead, monetization isn't quite as straightforward because it can show different pricing strategies with different consequent results. When buyers and sellers transact, one or both sides are charged of a fee from the platform. Moreover, as in the case of *Youtube*, when producers create content to engage consumers, the platform may monetize consumer attention (through advertising). Sometimes, one side may be even subsidized to participate on the platform.

- Regarding the **diffusion process**, platforms can *scale up*, both term of users and value, much *faster* than traditional linear value chain-based businesses thanks to the role of *network effects* and the possibility to leverage potential *zero marginal* *cost* mechanisms (since platforms do not own physical assets to offer the service) in easily reaching *critical mass*.

- Lastly, another crucial difference between linear and platform BMs is the **value creation curve**. In traditional linear businesses, the value creation curve typically flattens out as the number of consumers increases. A linear firm gains no particular advantage as its user base continues to increase beyond already efficient levels, which enables multiple competitors to coexist.

  Instead, many platform businesses become more and more valuable as more people and companies use them, make *interactions* and create network effects.

  These dynamics affect the nature of ***competition***. Indeed, traditional value chain models make it possible for several competitors to *coexist* and provide differentiated value to attract users (thus creating less concentrated markets). That's the dynamic in the auto industry today, with many car manufacturers competing to offer a variety of differentiated products. While the economics in platform context, will increase the *market power* of the competitor with the largest scale and the largest network of users. As a consequence the market become much more concentrated and this is why there's a the risk of *winner-takes-all* situation and monopoly price setting.

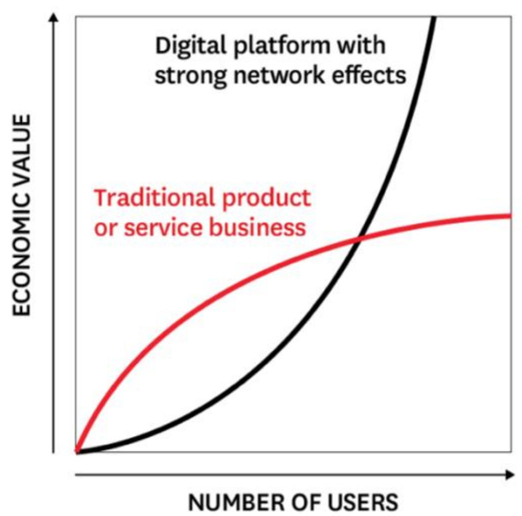

Figure 8. Value creation curve pattern for traditional value chain and platform models.

In the end, in order to avoid their disruption, it's very likely that in the future, every company will try to reorganize their business models from linear to network business models, from limited pipes to intelligent platforms.

3 BLOCKCHAIN TECHNOLOGY

In this chapter, I will introduce **blockchain technology**, its main features, potential applications and criticalities.

Blockchain is defined as a distributed transactional **database** made up of nodes connected in a *peer-to-peer* network. Access to the network is based on a permission mechanism, which allows the nodes to make transactions that are validated trough a consensus mechanism. As the name suggests, blockchain is first of all a chain of blocks and is part of a group of technologies called **Distributed Ledger Technologies** (DLTs). DLTs are digital, decentralized systems that record transactions and their details in multiple places at once.

It makes it possible to build applications and services on top of a peer-to-peer network that can authenticate transactions. This lets peers do business without the need for a central platform, reducing the risk of a *single point of failure* and establishing *digital trust* (Gayvoronskaya and Meinel., 2020). In contrast to centralized ledgers, each participant in the network keeps their own copy of the data. Consensus mechanisms are in place to make sure that the data is correct. These mechanisms make sure that everyone agrees that new data in the ledger is correct before it is added to the network.

Overall, blockchain, considered as a **General Purpose Technology** (GPT), has the potential to *re-define* the way people interact and trade value, information, goods, and services (Conte de Leon et al., 2017).

3.1. ORIGINS OF THE PARADIGM

Nearly a decade has passed since Satoshi Nakamoto first proposed the idea of blockchain technology. As a result, we can state that blockchain was created in *2008*. On that date, in fact, an individual or a group of people writing under the name Satoshi Nakamoto published an article called "*Bitcoin: a Peer-To-Peer Electronic Cash System*" in which they described Bitcoin as "*a purely peer-to-peer version of digital currency that allows online payments to be made directly from one user to another without having to go through a financial institution*". It was the first time a distributed network was combined with cryptography to enable peer-to-peer transparent and secure transactions of a crypto currency known as bitcoin. However, because of its complexity and volatility, blockchain's application was first restricted, but it has now attracted global interest. This diffusion pattern is in accordance with Everett Rogers' innovation paradigm, according to which, the ***adoption curve***, identified as *S-curve*, which describes the overall process of interest and acceptance toward a new technology, is characterized by a few years of gradual adoption followed by exponential growth (Lee and Jang., 2020).

Nowadays, blockchain technology is regarded as a *game-changer* for the fourth Industrial Revolution. Countries and businesses all around the world have begun to prioritize blockchain as a top strategic priority and to take action in this regard. When it comes to data, Deloitte (2018) stated that over half of the world's leaders ranked blockchain as one of their top five priorities. There has been $1 billion of total investments in blockchain technology, in 2016 and by 2025, blockchain investments are expected to reach a total of US$176 billion and US$3.1 trillion by 2030.

"*The Economist*" (2017) compared blockchain to a "***trust machine***" and said that "*the blockchain will change the world*". The *Gartner* Report said that it is one of the developing technologies with the most "*inflated expectations*". The blockchain is a model that leverage several technologies, such as smart contracts, *peer-to-peer transactions*, decentralized and distributed networks, and *cryptographic algorithms*. A blockchain is basically a database that is used during transactions. It stores information or data in the form of blocks, which are then linked to make a chain. The blocks are encrypted to make sure that the data is safe and correct, and the network itself checks the blocks to make sure they are correct.

Several big names in IT have paid attention to blockchain's growth, which has given them a chance to grow their businesses. IBM has created BaaS, which stands for "***Blockchain as a Service***". This is a service platform that lets customers use the blockchain to build their own businesses. Also other big companies like Linux (Hyperledger project), Facebook (Libra project), Amazon (QLDB), Microsoft, EY, Deloitte, PWC, NASDAQ (stock market), are working on and launching their own solutions. Also, more than 70 banks around the world are said to be starting to think about and use blockchain solutions (Ramasamy and Kadry., 2021).

3.2. KEY CHARACTERISTICS

When a new piece of information or data comes in as a result of a transaction, it is added to the chain in a new block. As the information and data keep coming in, they form a real chain of blocks, which is where the name of the technology comes from. Every time a transaction is made, a new block is made and added to the chain. This makes the chain bigger as more transactions are made.

In a blockchain-based distributed network, each member is in charge of keeping the entries up-to-date, approving them, and making sure they are correct. There is no central authority, so each participant is responsible for making sure the network is valid and safe. Even if members didn't trust each other, they had to agree on something through a common **consensus** in order to keep trust. Below are the basic architectural parts of the blockchain (Wang et al., 2018):

Block: A block is the basic data structure element of the blockchain that represents a sequence of blocks, which holds a complete list of transaction records like conventional public ledger. Each block points to the immediately previous block via a reference that is essentially a hash value of the previous block called parent block. The first block of the blockchain is called '*genesis block*', and it does not have the *hash* for the previous block as it does not have any parent block. These blocks may be created by any of the node within the network and must be accepted by all other nodes in order to be added into the blockchain. The maximum number of transactions that a block can contain depends on the block size and the size of each transaction.

Ledger: The ledger is the *public register* in which all transactions are listed in an orderly and sequential manner with maximum transparency. Through an encryption function and the usage of hash, it is made up of a chain of blocks.

Transaction: is one of the pillars of the blockchain platform's architecture. The receiver and sender's addresses are included in the *transaction* data. A digital signature is applied to the hash of the preceding transaction before the data is sent. It then becomes public knowledge and can be used by any nodes to determine their present state by using all of the blockchain's transactions as a starting point.

Digital signature: Each user has a private key and a *public key* for usage in digital signatures. Transactions are signed using the *private key*. Transactions using digital signatures are disseminated over a network and can be accessed by anybody with access to the public keys.

Hash function: In order to prove that the information being transferred has not been tampered with, an hash function is utilized. As long as the subject has access to the right hash of the input data and can compare it to his own, the data is safe: if there is a discrepancy, the data has been tampered with; if there is a match, it is highly likely that the data has not been altered. A new block of transactions must be validated, and encrypted before it can be added to the Blockchain. Once this phase is completed, it can then be added to the Blockchain and become active. A "*miner*" is a person who voluntarily validates transactions and adds a block to the Blockchain chain. A consensus process is used by the miner to ensure the integrity and security of the Blockchain. It is possible for anyone to become a "miner" and compete for first place in solving a complex mathematical problem relating to the formation of each new transaction block.

Peer-to-peer network: Since in a distributed system without a *central authority* all nodes are equally important and have equal power, blockchain operates on a peer-to-peer network.

Consensus protocol: The blockchain is safe because of the *consensus protocols*. Each person should have a current, identical, and consistent copy, as this is the responsibility of the consensus mechanism. The new block is only uploaded to the blockchain once all the nodes have given it their blessing. With equal rights, cooperation, and involvement, consensus aims to reach an agreement between all the nodes in the network.

3.2.1. CONSENSUS MECHANISM

"*How is a new block added to the blockchain?"* is a question that is answered by consensus procedures. Proof-based consensus algorithms and voting-based consensus algorithms are the two main types of consensus algorithms that could be implemented in a blockchain. The proof-based consensus approach is best suited for networks with a large number of participants. While, voted-based algorithms are better suited to circumstances where there are only a few nodes involved. In recent years, a number of consensus methods have been created. **PoW** and **PoS**, are the two most widely employed algorithms (Conte de Leon et al., 2017).

3.2.2. PROOF OF WORK

PoW is a system that use computational resources to verify the work done by users and it's the proof used in Bitcoin blockchain.

Creating a proof of work is challenging (both in terms of *cost* and *time*), but once it's done, it's easy to verify by others and meets specific criteria. A lot of trial and error may be necessary before a valid proof of work can be obtained since producing a proof of work can be a random process with low probability. The proof-of-work algorithm used by Bitcoin is called ***Hashcash***. PoW calculation is known as "**mining**", in this context. It works in this way: In the block header, each block has a random value called "*Nonce*". By changing this "Nonce" value, Proof of Work has to come up with a number that makes the block header hash value less than a target value that has already been set.

New blocks are generated by the network at a rate of one every 10 minutes because of the difficulty of this operation. In the end, Proof-of-work also uses a lot of *energy*, which is neither good for the environment nor for the economy (Gayvoronskaya and Meinel., 2020).

3.2.3. PROOF OF STAKE

PoW is supposed to be *unfair*. Indeed, some miners can own very powerful hardware and work together to make it easier to find a valid nonce. This is very different from Satoshi Nakamoto's original idea, which was that everyone should try to solve the puzzle and get a reward. Proof of Stake is meant to make up for this potential discrimination. **PoS** changes how much computing power and energy are needed, like PoW does, and replaces them with stake. **Stake** is the amount of a certain currency that an actor is willing to lock up for a certain amount of time. In exchange, they get a chance of winning that is proportional to the *stake* they put in selecting the next block.

Also, if you use PoS, an attacker would need to own at least 51% of all stakes in the network to do a hacking attack which is very unlikely because the attacker would have to buy a lot of resources (Lee and Jang., 2020).

3.2.4. PROPERTIES

In short, blockchain has the following main *features* (Wang et al., 2018):

- **Decentralization:** It means that a transaction can be done directly between peers without the need for a third party to verify the transaction. Thanks to this property, it is possible to save money on transaction costs.
- **Auditability**: A confirmed transaction is recorded in the blockchain in order of when it happened. Users can easily check on past transactions and keep track of them by going to any node in the distributed network. The data in the distributed shared ledger can be more clear and easier to find with the help of blockchain technology.
- **Persistency**: Honest miners won't accept a transaction that isn't valid because everyone will synchronize and keep a ledger after transactions have been checked. There is almost no chance that someone can change the status of a transaction in the blockchain or delete it.
- **Transparency, Security and Immutability**: Thanks to the technology of cryptographic hash and consensus mechanism, a shared ledger in a blockchain can't be changed and gives a historical version of the truth. With a consensus mechanism in place, people will be more likely to trust each other. Because of this, users can't change a validated record unless they have the power to control most of the computing power in the blockchain.

- **Anonymity**: When users start a transaction, they can make up an address to replace their real name so that their real name doesn't get out. The privacy of transactions in a public blockchain will be kept safe.
- **Time stamping**: Each transaction in the blockchain is made in the form of a block, which is stamped with the time in order. This shows the users the full history of all transactions and ensures that everything is clear and can be found. It not only guarantees that the data is original, but it also backs up the idea that the blocks are permanent.

3.2.5. TYPES OF PLATFORMS

Since bitcoin was proposed and made to work using the blockchain network, the technology has become very popular, and many platforms that use the blockchain mechanism have been developed (Zheng et al., 2018):

Ethereum was started in 2013. It provides an open-source platform based on blockchain network. It is used to enable smart contracts on blockchains that have been customized. It is a public blockchain that uses proof-of-stake and users of Ethereum Ethers are charged in the form of Ethers.

Hyperledger fabric builds blockchain-based apps by using a modular framework. This platform is different from others because it gives users the freedom to add components in any way they want. This is a permission-based system, which means that each node must ask for permission to join the network.

Corda: The R3 consortium, which is the largest financial group in the world, made the R3 Corda platform. It makes it possible for different businesses to deal with each other directly, without the need for a middleman. It is also a blockchain network that only lets people who are allowed to access the data into it. It was first made for use in the financial industry, but now it is used in many different fields.

Ripple is a platform that helps banks, digital asset providers, exchanges, and other businesses talk to each other through a blockchain-based network called RippleNet. It also promotes a digital currency called Ripple, which is used for transactions. It uses probabilistic voting to reach a consensus among the nodes, which is thought to be faster and easier to scale.

Quorum is a blockchain-based network that was started by Ethereum developers and J.P. Morgan. It is an extension of Ethereum that is mostly used by businesses. Since it is an extension of Ethereum, it is also a free platform with open source code. It uses a method based on votes to handle the transactions. The nodes of this network are not open to the public because it uses a permission-based blockchain.

3.2.6. PRIVATE VS PUBLIC

Public blockchain: A public blockchain is a decentralized network that anyone can use without asking for permission. Anyone can join the network and become an "*authorized node*" if they want to use the blockchain. Since anyone can join a public blockchain, it is usually very big. This makes it safer because the records are spread out more the longer the chain is. Also, it is *transparent* because the ledger with all the records is open and can be seen by all the authorized nodes. But even with all of these benefits, public blockchain has a few problems. For example, it takes a long time to process transactions because the network has a lot of nodes and each transaction needs time to be verified. This also makes it hard to add more nodes to the network, which is a problem for scalability (Conte de Leon et al., 2017).

Private blockchain: A private blockchain is a permission-based, distributed network that only works within a *closed* network and has some restrictions. Most organizations that want only certain members to be able to access and take part in the network, prefer these blockchains. No one outside the network can get to the information, either. The people in charge of the organization have full control over everything. These networks can be used to manage things like identities, who owns what, the supply chain, etc.

Private blockchains are faster and can grow more quickly than public blockchains. Since the number of nodes in these networks is limited, the speed is higher because the verification and consensus processes don't take long. This makes the network more *flexible* and *scalable*. However, since there are fewer nodes, it could be easier for security to be broken or for the whole network to be hacked (Conte de Leon et al., 2017).

3.3. TOKENS

The necessity to trade something else than the underlying cryptocurrency has grown on top of current blockchains. The concept of '**tokens**' emerged to cover this need. Typically, a token is described as a countable thing that may be virtually manipulated. In this spirit, the *ERC 20* is a set of guidelines for how a token should be built and what features it should have. ERC20 provides a standard way to build tokens that can be used as currencies on the blockchain, as well as a basic tool interoperability definition (Wang et al., 2018).

More specifically, tokens are a collection of rules that are expressed in a specific kind of smart contract known as a *token contract*. A token contract is a smart contract with a map of account addresses and balances. The balance represents the contract creator's defined value: it might be any existing digital or physical item, or access rights to assets owned by others. The token contract manages the validity and security of cryptographic tokens, as well as the underlying distributed ledger, by majority consensus of network nodes (Lee and Jang., 2020). Tokens are represented in the ledger as an entry and are mapped to the blockchain address, which represents the token holder's blockchain identity. Tokens can only be accessed through a dedicated wallet application that communicates with the blockchain network and manages the public-private key pair associated with the blockchain address. Tokens provide more transparent, efficient, and equitable interactions between market participants at minimal costs by facilitating collaboration across markets and countries (Zheng et al., 2018).

3.3.1. TOKEN ECONOMY

Token economies are the economics of goods that have been *tokenized*. Blockchain and token economies offer a way to connect the real and virtual worlds that are becoming more and more connected. In a token economy, blockchain technology is used to *digitize* physical assets, prove who owns them, and make them possible to trade; tokenizing an asset that is already in digital form works the same way. Token economies are basically a digital version of how people and things interact in the real world. They are based on measurable units, *tokens*, are governed by algorithms, and are kept safe by cryptography (Ramasamy and Kadry., 2021).

3.4. SMART CONTRACTS

Nick Szabo came up with the idea of smart contracts in *1994*. A smart contract is a computer program that can automatically secure, enforce, and carry out agreements between parties. A smart contract is a *computerized protocol* for making transactions that carries out the terms of a contract (Conte de Leon et al., 2017). They represent an essential part of the blockchain and are called "*blockchain 2.0*" because they are the next step in blockchain technology development. A smart contract is a *piece of software* that is programmed with the terms and conditions of a contract between two parties. This information is kept on a blockchain (Gayvoronskaya and Meinel., 2020). A smart contract is basically an *agreement* between two or more parties who may not completely trust each other but have agreed on certain terms and conditions that the contract will enforce. In blockchain, smart contracts are scripted and run on the decentralized network without trusting any central authority or third party. Smart contracts could change how multi-sided platforms provide value to their users by putting the technical features of blockchain technology to work for these businesses and lowering their operating costs.

3.5. DECENTRALIZED APPLICATIONS

Decentralized applications, or **dApps**, combine multiple smart contracts to enable complex interactions between parties. A decentralized application differs from traditional applications, as they are *trustless* and run on a peer to-peer network of computers instead of a single computer. This means that the backend of the application relies on blockchain technology, including the smart contracts. New use cases of decentralized applications being developed. One example relates to the decentralization of marketplaces. In general, there are different applications of blockchain technology that involve smart contracts that could be used to create decentralized multi-sided platforms (Ramasamy and Kadry., 2021).

3.6. ORACLES

As we've already said, the blockchain is a *consensus-based* system. This means that it only works if, after each transaction and block, all nodes end up in the same state. However, if nodes need to get information from outside sources in order to accomplish the contract, since this source is not part of the blockchain, there is the risk that every node will get different information. The consensus mechanism would be broken if the source gave different answers to requests from different nodes.

The solution is relying one or more trusted parties, called "**oracles**," to create transactions that add external data to the blockchain. This way, every node will have an identical copy of this data, so it can be used safely in a smart contract computation (Wang et al., 2018). So, you can think of an oracle as a way to connect the blockchain to the real world. It works as an on-chain API that smart contracts can use to get information (Zheng et al., 2018). It could be about anything, like the weather, a payment that went through, a delivery of physical goods or price changes. Oracles can also be used to "send" information out into the real world. However, since oracles are third-party services that are not part of the blockchain consensus mechanism, they are not subject to its security features. This represents a *risk* for the network.

3.7. APPLICATION FIELDS

Thanks to its potential for disintermediation, blockchain's *disruptive* impact could have wider use cases across different industries (Ramasamy and Kadry., 2021):

• **Cryptocurrencies & Finance**: Blockchain is employed in banking, asset settlement, prediction marketing, etc. In the banking industry, thousands of transactions include money and other assets every second, making blockchain an excellent solution. Blockchain can help banks save on storage, speed, and energy. Blockchain is used for loan management, digital payments, financial auditing, banking services, cryptocurrency, etc. Blockchain provides a secure mechanism to trade money and a transparent platform with cheap operational costs. It also eliminates the need for intermediaries, making it cheaper because managing them is expensive. Blockchain eliminates all these risks from the finance network by reducing the number of middlemen.

• **Healthcare & Welfare**: The healthcare industry may use blockchain to provide a transparent infrastructure for storing and analyzing data. It can help develop new medicines and reduce healthcare costs. Several studies focus on secure data management, medical image sharing, digital contact tracing, and medical records archiving. The blockchain can help analyze data from intelligent devices, trace the origin of pharmaceuticals, record adverse effects, etc. Pharmacies might also use blockchain to trace supply chain information between producer, consumer, and vendor.

• **Security & Privacy**: Today's data is vast and heterogeneous, requiring security and privacy. Using blockchain technology can improve system security and scalability.

• **Corporate & Economy**: Blockchain-based can be used to manage some business processes. For instance, it could be implemented to manage company product supply chains, supply and demand, automatic payments, etc. Blockchain can also be used in e-commerce to authenticate goods ownership and identify fraudsters; e-markets may also employ blockchain for online payments or to rate sites and products in e-business. Blockchains can also control real vending machines by preserving accurate and updated product availability information.

Asset Tokenization: The blockchain-based tokenization of digital assets is a noteworthy breakthrough. Tokens represent specific data on the network and will help to simplify and secure the process of storing and transferring assets. Tokenization improves the immutability of data stored on blockchain networks even further. It also has the ability to improve the efficiency and security of a variety of processes and activities in various industries.

Blockchain As A Service: In the past, it was difficult to locate and use blockchain technology. Fortunately, blockchain as a service (BaaS) platforms are now available, allowing many institutions and companies to receive a template for adopting blockchain in their operations. The development of specialized platforms can be time-consuming and costly, which is why the promise of blockchain has not been fully realized in earlier years. With the rise of BaaS, various sectors, including the research industry, may now easily use blockchain's potential and profit from its incredible benefits when it comes to data management.

- **Governance & Citizenship**: The government has traditionally kept citizens' and government-based organizations' records. Blockchain can secure government infrastructures. Blockchain governance aims to decentralize the same services and facilities for citizens. Marriage registration, legal documents, contracts, voting, etc. are blockchain-governed services. World Citizen Project is a blockchain-based passport service that identifies worldwide residents. Since technology and the Internet are growing widespread, a blockchain-based platform could be an intelligent solution for maintaining personal records like name, credit score, and personal traits. Blockchain can be utilized for e-resident platforms, taxes procedures, property administration, etc. E-voting is another area where blockchain can cut costs and prevent false voting.

Existing e-voting systems can be hacked or infiltrated by simply taking over a central authority. Adapting the distributed environment makes it secure, and blockchain makes polls transparent and traceable.

Internet of Things (IoT): is one of the most prominent IT fields in the past two years. The number of IoT-connected devices could reach 500 billion in the next decade. IoT will impact practically every business on a major scale, not simply smart devices and houses. Future world will be smarter, more connected. In today's context, each IoT failure causes the loss of personal data that affects individuals and organizations. IoT security focuses on device transactions and database connections. IoT can be linked with blockchain for safe and secure transactions, and its decentralized nature would prevent the loss of personal data. Integrating IoT and blockchain would increase confidence, speed up transactions due to their distributed nature, and eliminate the need for an intermediary, creating a low-cost system.

3.8. CRITICALITIES

Blockchain technology is still immature. To reach the full potential of the technology, some main issues should be solved (Lee and Jang., 2020):

• **Consensus Protocols**: Blockchain combines technology like distributed networks, decentralized mechanisms, cryptographic algorithms, time stamping, etc. In order to efficiently use the blockchain platform, we must improve its technological aspects. A blockchain-based system's consensus method imposes rules on nodes and requires *time* and *resources*. As blockchain transactions need to be *speedier*, consensus techniques could be improved to increase system throughput. Researchers are evaluating several protocols for the same so the system can have higher security, scalability, and low cost and power consumption.

• **Scalability**: In blockchain, a block is formed anytime data is generated or modified. It also records the history of all transactions and distributes a copy of the data to all nodes in the network. These elements ensure transparency, openness, security, and data availability. However, this method creates a lot of data and needs a big *storage space*. Efficient blockchains require more effective solutions. As the number of transactions grows, a single node can't handle so much data, hence a blockchain reconstruction or storage extension is needed.

- **Regulations**: While blockchain has revolutionized the IT industry's ecology, it has also affected *governance* and law. Due to its uniqueness, it's still *unregulated*. To strengthen blockchain legislation, a better understanding is essential.

4 INNOVATION BROUGHT BY BLOCKCHAIN TO BM

After having introduced an overview of the blockchain technology, its main features, potential fields of application and future improvements, it's important to understand the impact of this technology on business models. Indeed, blockchain technology offers different *opportunities* to innovate business models as it enables new ways of organizing economic activities, reduces costs associated with intermediaries, improves *operational efficiency*, and strengthens the trust in an ecosystem of actors.

In the last few years, researchers have been mainly trying to figure out the technical aspects of blockchain protocols and practical applications. Much less effort has been put into recognizing its wider implications from organizational and managerial perspectives, and the extent to which it could disrupt traditional business models.

Despite this lack of literature interest, for the purpose of this report, it's useful and meaningful to analyze how blockchain technology can create business value for firms' respective business model (Lacity, 2018), as well as spot which business model patterns have proved to be already successful for this new foundation technology. Based on these premises, this chapter aims to provide an answer to the following two questions:

1) *How different types of blockchain impact business models components?*

2) *What are archetypal business model patterns for firms adopting blockchain technology?*

To answer the identified questions, I will mainly refer to two scientific articles. For the first question I will refer to the literature review conducted by Vella et al., (2021). The review is based on 61 scientific articles with the aim of defining the impact of blockchain on business models. For the second answer, I refer to the work conducted by Weking et al., (2019) that described a taxonomy of five archetypal patterns of blockchain business models, which enhances the understanding of how blockchain technology affects existing and creates new business models.

4.1. IMPACT ON BM ELEMENTS

In order to start the discussion, it's necessary to consider two frameworks: the business model stricture and the different stages that characterize the evolution of blockchain applications.

4.1.1. BUSINESS MODEL STRUCTURE

The concept of *business model* has been highly studied in recent years, and different scholars proposed significantly different perspectives (Trabucchi et al, 2019).

In accordance with the review of Vella et al (2021), I consider the definition for *Business Model (BM)* proposed by David J. Teece (Teece, 2010) that defines the business model as a company's architecture of value, representing the way a firm generates value for its target customers (*value creation*), delivers value to such target customers (*value* *delivery*), and captures a share of such value to make its business sustainable (*value capture*).

The business model is a source of efficiency for firms and entrepreneurs because it allows managers to reflect on how to optimize value creation, by multiplying its sources, and value capture, by increasing revenue within and outside the firm's boundaries (Chesbrough and Rosenbloom, 2002; Teece, 2010).

To conduct a structured discussion, we refer to the most famous and complete business model framework, the **Business Model Canvas** illustrated by *Osterwalder* in 2004 (Osterwalder, 2004). This framework has been widely used and validated by practitioners and academics all over the world. Because of its completeness and coherence in addressing all aspects and related relationships that contribute to building companies' strategy, the business model canvas has been chosen as the reference model for analyzing blockchain impact on business logic.

The components introduced by the canvas represent a more detailed level of description of the value dimensions of the BM (Osterwalder and Pigneur, 2010):

- *Value Creation* components
    - *Key Partners:* "The network of suppliers and partners that make the business model work". These partnerships may take forms such as strategic alliances, joint ventures, or buyer-supplier relationships.
    - *Key Resources and Activities:* "The most important assets required to make a business model work".
    - *Value Proposition:* "It includes all of the firm's activities that create value for customers". These resources may be physical, financial, intellectual, or human.
- *Value Delivery components*

- *Customer Relationships:* "Describes the types of relationships that a company establishes with specific customer segments". These relationships may be driven by a motivation to acquire customers, to retain customers, or to boost sales.
- *Channels:* "Describes how a company communicates with and reaches its customer segments to deliver a value proposition". These channels may be the company's own sales force, website, or stores, or the channels may be the stores of its partners or wholesalers.
- *Customer Segment:* "The different groups of people or organizations that an enterprise aims to reach and serve".

- *Value Capture* components
  - *Cost Structure:* "Describes all costs incurred to operate a business model".
  - *Revenue Streams:* "The cash that a company generates from each customer segment".

These parts, when combined and properly aligned, create and deliver value. Osterwalder and Pigneur (2013) condenses these nine important parts of a BM In a visual canvas. The canvas, which is commonly drawn on a big sheet of paper and divided into parts for each of the model's elements, is used to define, update, or analyze a company's business model. (Morkunas and colleagues, 2019)

4.1.2. EVOLUTION OF BLOCKCHAIN APPLICATIONS

Since its very first introduction in 2008, blockchain has successively evolved over the last decade, expanding its scope and potential usages: from the use of cryptocurrencies to the development of decentralized applications.

The different types of usage of this technology could influence the impact on firms' business models. Therefore, to better understand the impact of blockchain on firms is essential to first categorize the types of blockchain applications.

The different kinds of blockchain technologies and uses are linked to the following four stages of maturity described by Angelis and Ribeiro da Silva (2019):

Blockchain 1.0, is primarily linked with transactions, particularly the usage of cryptocurrencies in cash-related applications such as currency transfer, remittance, and digital payment systems. The reduction in transaction costs is directly tied to Blockchain 1.0. This is true not only in a financial sense, but also in terms of removing the requirement for a central authority to assure secure transactions. Decentralized consensus saves expenses by eliminating middlemen, for example.

The most well-known example is Bitcoin, a decentralized digital currency in which encryption techniques are used to allow peer-to-peer transactions in a system that works without a central bank or single administrator.

Blockchain 2.0, is a step forward. Privacy, smart contracts, and the advent of non-native asset tokens are all part of blockchain 2.0, which is an extension of blockchain 1.0. Parties who are not well known can trust one other thanks to smart contracts, which eliminate the need for middlemen to act as guarantors. This also implies that blockchain is no longer restricted to the financial sector. Smart contracts' transparent and autonomous nature reduces the danger of manipulation and inaccuracy, in addition to eliminating many middlemen. A well-known example of a platform that runs smart contracts is Ethereum.

Blockchain 3.0 extends the focus of the blockchain to include decentralized applications (dApps); a dApp is a back-end application that runs on a decentralized peer-to-peer network that connects users and suppliers directly. This open-source software platform uses cryptographic tokens to construct decentralized blockchains. It alters the more traditional transaction structure and, in most cases, necessitates governance adjustments because the services offered and the underlying support functions are out of the main organization's direct control.

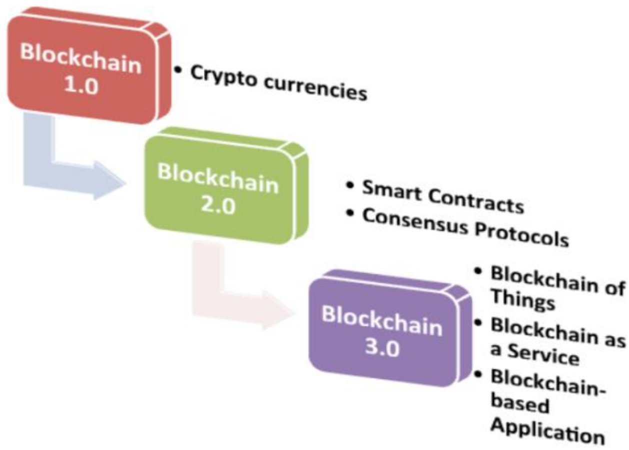

Figure 9. Blockchain usages illustration

Angelis et al (2019) also introduced the concept of blockchain 4.0, defined as the applications that involve the inclusion of artificial intelligence (AI) to blockchain technologies. This allows systems to make decisions and act on them without the need for direct human interference.

In the following subsections, it's possible to get insights and examples of how each of the nine BM components could be affected by the different types of blockchain usages above introduced. However, since its application is still not extensively used in business, blockchain 4.0 is ignored.

4.1.3. BLOCKCHAIN 1.0 IMPACT ON BM

The adoption of blockchain 1.0 offers an alternative to traditional transactions by eliminating intermediaries between involved parties. All the value architecture dimensions are impacted by the employment of this first type of blockchain, and value creation is the most influenced one.

KEY ACTIVITIES

Because of the ability to accumulate trustworthy data linked to transfers, blockchain 1.0 adoption can reduce activities related to money transfers. Blockchain 1.0 provides transparency during transfers, allowing for an overall simplification of the process by enabling secure access to the essential information for all participants and removing the need for multiple and repeated data exchanges.

VALUE PROPOSITION

Blockchain 1.0 is a solution to the limitations of existing payment methods. When compared to typical centralized payment systems, distributed payment services provide instant, low-cost, and borderless payments, lowering service prices for both sellers and consumers. This allows users of the blockchain network to access direct value exchange services with lower transaction fees due to the absence of third parties (such as banks), lowering the overall cost of accessing previously centralized services for customers. An example is Centbee, an African startup, that enables users of its mobile app to send bitcoin to users' contact lists. Centbee users can move money simply and cheaply across borders to support family and friends without incurring in tremendous currency exchange fees.

CUSTOMER SEGMENT

Because centralized institutions are less involved, services are cheaper, and new clients can be attracted. Furthermore, because cryptocurrencies are not tied to any one authority or country, they are effectively borderless, allowing anyone with an internet connection to send money to anyone else (Chen and Bellavitis, 2020). Cryptocurrencies, in particular, can have an effective impact in developing economies, where blockchain adoption can promote financial inclusion for businesses and individuals. An example is Everest, a firm that uses a private and permissioned Ethereum-based protocol, provides a decentralized distributed ledger technology that incorporates a payment solution, a multicurrency wallet, and a biometric identity system to facilitate microfinance transactions, land claims, and medical records to customer segments in developing countries that have limited or no access to financial services.

COST STRUCTURE

Companies can take use of blockchain's lower transaction costs to save capital during money transfers when compared to traditional payment methods. By 2022, blockchain technologies are estimated to save $15—$20 billion annually in the financial services industry (Gregorio, 2017). These savings come from lower IT infrastructure expenditures and the elimination of manual operations that added little value to the company.

REVENUE STREAMS

Improvements in the firms' ability to manage cash flows, cash balance management linked to the increased transparency and transaction tracking features introduced by the distributed ledger, can lead to an optimization of the overall revenues.

4.1.4. BLOCKCHAIN 2.0 IMPACT ON BM

Blockchain 2.0 application expands the idea of purely monetary value of this technology. This second type of application is characterized by the use of digital assets and smart contracts to allow companies to do business with untrusted parties without the need for a trustworthy intermediary.

KEY PARTNERS

Firms can now reach out previously unreachable strategic partners through the use of smart contracts for managing contractual relationships and the increasing availability of trustworthy data. They can form alliances in an open, transparent network without fear of copyright issues or lock-in, allowing them to take advantage of coopetition (simultaneous cooperation and competition). As a result, blockchain increases the openness and security of operations, resulting in new business connections ranging from long-term, trust-based collaborations to shorter, more flexible ones, where partners are chosen based on their offered competences rather than existing trust.

Moreover, the use of blockchain can also enable the addition of new partners such as technology companies that develop application programming interfaces (APIs) and software development kits (SDKs), and maintain the transactional algorithms.

KEY ACTIVITIES

Smart contracts enable businesses to totally automate business activities such as billing and payment in a variety of industries. As a result, businesses can offer products and services to clients while also collecting payments immediately after the required product or service is accessed, improving overall process efficiency.

KEY RESOURCES

Blockchain technologies force firms to reconsider the key resources that composed their business model. Firms can experience an increase in resource fluidity thanks to the establishment of a new ownership paradigm, shifting from the original possession of assets towards flexible access to resources when needed (Morkunas et al., 2019). In some particular cases, firms can even avoid investments in IT infrastructure because, in the case of public blockchains, the network provides these resources and processes.

Moreover, the increased efficiency of operational processes and activities, thanks to automation, allow firms to gain more flexibility in resource management and focus on value-adding activities due to the disengagement of human and technical resources.

Another important aspect of how resources and activities can be affected by blockchain technologies is when the users provide many of the key resources and processes and use blockchain technologies just to facilitate resource exchange. Using the example of smart contracts in real estate transactions, resources such as human capital (e.g., knowledge, skills, experience) and physical capital (assets) are provided by the transacting parties while blockchain technologies facilitate the peer-to-peer exchange of these resources. (Morkunas et al., 2019).

VALUE PROPOSITION

Blockchain 2.0 can be used to establish a distributed database where data is stored transparently and securely, resulting in trustable, traceable, and immutable data and a reliable history of exchanges that is always visible to all network members. This distributed database serves as a single source of truth for all entities that rely on such data, increasing product information accountability, verifiability, and traceability, allowing for increased safety, detection, and prevention of illegal activities while reducing the need for a third party to establish trust between untrustworthy parties.

For instance, working with a notary for home purchases or sales requires time and is often expensive. Here, blockchain technologies can reduce the transaction cost and time for the respective parties ensuring, at the same time, reliability and verifiability of the data. This may be achieved by using smart contracts. As an example, ChromaWay's private blockchain protocol enable Swedish citizens to use smart contracts to purchase or sell a house and reduce time and costs during the transaction.

Also, the process of tokenization for which assets, physical or digital, are represented as tokens in a blockchain-based environment, supports and reinforces the broaden Internet of value potential of blockchain 2.0 by offering users new sources of value not only monetary. (Vella et al, 2021).

CUSTOMER RELATIONSHIPS

Tokens and smart contracts help to automate consumer interactions. The issue of tokens through initial coin offerings (ICOs), to engage people in future product and service releases while generating funding to develop the project, is an example of this interaction. This process is carried out automatically by smart contracts and does not necessitate any dedicated client resource. Companies can employ tokens to develop token-based reward systems, which will increase consumer engagement, community, and lock-in (Mas et al., 2020; Rijanto, 2020; Schneider et al., 2020).

CUSTOMER SEGMENT

Blockchain 2.0 encourages the expansion of a company's client base by allowing ultimate customers who don't really believe displayed information disclosed by firms to participate in the business model. This is due to the increased product safety and standard compliance given by blockchain applications, which allows businesses to build customer trust and increase positive brand perception and loyalty.

COST STRUCTURE

The impact on the costs structure component is strictly linked to key activities A reduction in operational costs connected to business activities and processes, is a direct result of the simplification of business operations due to improved automation, increased information availability, and reduced coordination activities effort (Vella et al, 2021).

REVENUE STREAMS

Innovative fundraising initiatives such as ICOs, a blockchain-related crowdfunding solution that allows enterprises to collect funds from many investors without the use of a financial middleman, have made Blockchain 2.0 more accessible to businesses. Furthermore, blockchain 2.0 permits the creation of new monetization sources for clients, allowing them to profit from previously unavailable value sources.

4.1.5. BLOCKCHAIN 3.0 IMPACT ON BM

Blockchain 3.0 introduces the concept of Decentralized Applications (DApps) which are constituted by computer codes running on decentralized systems instead of centralized ones as for common apps. The use of the blockchain 3.0 has an impact on all three components of the value architecture, with value creation being the most impacted.

KEY PARTNERS AND KEY RESOURCES

The blockchain 3.0 divides the platform provider's job into two distinct actors (Trabucchi et al., 2020). As a result, new ties and relationships are formed: a blockchain network provider becomes a significant partner for a service provider who relies on its technical expertise and the blockchain network it provides (a new essential resource) to deliver value propositions to end users.

VALUE PROPOSITION

The value proposition is also split in two according to the new roles: blockchain provider offering platform as a service and service provider designing the final application on top of the current blockchain network. From the point of view of blockchain providers, they provide a comprehensive distributed ledger-based network on which customized business solutions can be built. Service providers, on the other hand, pay for access to a blockchain network that allows them to supply services/applications to their clients in order to meet users' business demands (Trabucchi et al., 2020). In blockchain 3.0 the technology is offered as an open-source platform to developers that can leverage these existing blockchain networks thanks to dedicated APIs (Weking et al., 2019) thus fostering cooperative innovation aimed at developing customized business applications independently from the application field (Vella et al, 2021).

CUSTOMER SEGMENT

Blockchain 3.0 lead to the presence of multiple service providers and gives potential multiple roles to user. Therefore, in these in two-sided blockchain-based platforms, there is an increase in the direct network externalities hence mitigating the chicken and egg paradox (Trabucchi et al., 2020).

REVENUE STREAMS

Blockchain 3.0 enables new sources of revenues due to the innovative value proposition offered. The greatest part of revenues for distributed ledger providers still comes from traditional flows, such as commission fees on purchases, advertising, and so on. Moreover, two additional sources called technology rental and token reselling, exists. The former regards the fees achieved from renting the technology to a third party and represents an additional fee inflow; the latter regards the money gained by the blockchain providers in reselling and transacting their network-related tokens.

4.2. OPPORTUNITIES TO INNOVATE

Because of what seen before, it's reasonable to state that blockchain offers several *opportunities* to innovate business models. Indeed, some of the features of this technology create real incentives to adopt blockchain-based BM. Depending on the implementation, these incentives could be related to significant *cost reductions* emerging from **disintermediation**, enhanced data *traceability* and verification or promotion of *trust* and engaging dynamics among members of the system. For instance, employing a blockchain-based business model enables the use of cryptography and tokenization. **Tokenization** allows the establishment of a rewarding system for stakeholders thus shaping a business model for *shared value*, while **cryptography** can substantially change a business model's value proposition as it ensures authenticity behind all interactions in the network (Weking et al., 2019).

Moreover, implications on the business model and business practices are also related to the underlying assets of the blockchain. Assets traded through the blockchain can be physical, digital, monetary, or user-specific. Implementing the blockchain technology for different assets provides various opportunities for changing and improving underlying business models and firm practices.

4.3. BM PATTERNS

To answer the second question, I refer to the analysis conducted by Weking et al., (2019) who derived 5 archetypal business model patterns for blockchain technology, based on a cluster analysis of 99 ventures that use blockchain as a fundamental technology of their business. Each *pattern* is linked with a particular application area such as *financial services, supply chain, two-sided markets* and *social welfare* and cover the emergent blockchain based BM.

These patterns demonstrate possible options for innovating a business model leveraging blockchain technology:

Pattern 1: Blockchain for Business Integration (BaaS)

The first pattern concerns the use of blockchain for Business Integration. Here, companies provide a standardized **shared database** that improves **interoperability** among actors of a value chain.

Different to other patterns, firms offer specific blockchain solutions to customers with a specific business need, instead of using the blockchain themselves. Therefore, their value chain position is *blockchain mediator*.

They typically use several underlying blockchain technologies and modified consensus mechanisms for a consortium of users. As revenue streams, operators typically do not provide a currency or token in the blockchain but charge their customers with periodic fees.

For instance, providers sell blockchain solutions for improving the data interoperability of other firms in a supply chain through the Internet of things (IoT) devices. The provider offers a system where IoT devices can generate data and communicate with the blockchain. Participants store all relevant asset information in the blockchain. Hence, every member can continuously track the current state of the physical assets. Such distributed databases enable smart contracts and can provide additional business value for customers. The challenge is to integrate every member's system in the blockchain solution to leverage its full potential. This increases data transparency, verification, and tracing for every participant in the blockchain ecosystem.

Modum is a typical example of this pattern. They offer services for supply chain monitoring using IoT sensor devices to generate data. They store data in a distributed database, granting access to every member on their blockchain. A characteristic of this pattern is that Modum provides its services for different industries, including pharmaceuticals and the supply chain in general.

Pattern 2: Blockchain as Multi-Sided Platform

The second pattern includes firms that use blockchain solutions to provide a platform, a **Multi-Sided market** and enable direct peer-to-peer transactions to overcome restrictions on what can be offered by whom, thus enabling new business models. In this case, the provider is the *owner* of the market.

Contrary to other patterns, the operators typically do not rely on additional technology. Users are mainly charged with transactional fees for making transactions into the blockchain. Some providers even offer two different tokens in their blockchain, for separating currency and assets (like NFTs that cannot act as currencies; e.g., Decentraland).

Platform providers integrate firms to offer complementary products or services. Therefore, they rely on industry partners as key partners. Some providers additionally enable users to offer or sell new assets using the blockchain and enable their customers to become complementors. The underlying asset is typically a digital or a user-specific asset. The former primarily regards enhancing online-gaming experiences (e.g., DMarket), whereas the latter mainly targets the distribution and selling of data (e.g., BitClave) or labor (e.g., Bitjob). Providers typically use the blockchain framework Ethereum and existing consensus mechanisms because their business does not require specific blockchain modifications.

Pattern 3: Blockchain for Security

Third, Blockchain for Security pattern concerns firms that uses cryptography for **security reinforcement** and enables services, such as ownership clarification, without physical authentication. Users may safely authenticate themselves thanks to the combination of trusted hardware and blockchain technology, and asymmetric cryptography allows only the corresponding owner to change the data or ownership. When an ownership change occurs, the distributed blockchain notifies all participants.

Several companies are addressing those aspects of blockchain technology in order to ensure distributed data security. The company's value chain position is blockchain *enabler* in this case. Many firms that belong to these patterns use an existing, modified blockchain, typically Bitcoin for a private network with its own consensus mechanism. Providers generate revenues with transaction fees and by generating their tokens.

The underlying assets are typically users' data. Providers often join forces with technology partners to strengthen security features.

An example is Bluezelle, who provide decentralized storage. They build on the enhancement of privacy, reliability, and immutability of blockchain solutions in addition to reduced costs compared with single system databases.

Pattern 4: Blockchain Technology as Offering

The fourth pattern includes firms that provide the **technical infrastructure** to enable blockchain-based BM. Basically, they offer blockchain-APIs to developers.

Compared with other patterns, they do not specify the underlying asset or provide a specific channel as they often distribute their API as an open-source.

Providers create highly specialized blockchains using modifications, such as the underlying consensus method, to separate themselves from existing blockchains and serve more specific business needs. Although they do not charge their customers, but instead, providers profit from the distribution of their tokens. They typically keep a portion of their tokens; a subsequent increase in demand leads to a higher value of those tokens and generates indirect income. Typically, they additionally accept other cryptocurrencies.

Examples include Qtum and Tezos. Both offer blockchain infrastructure to build decentralized apps, including the possibility of smart contracts and the implementation of the proof-of- stake-algorithm.

Pattern 5: Blockchain for Monetary Value Transfer

The fifth pattern is linked with the use cryptocurrencies and **reduction** of transaction costs to enable **direct** seamless value transfer among peers.

Many businesses have recognized the benefits of cryptocurrencies and have included it into their value transfer platforms. This "*Blockchain for Monetary Value Transfer*" business model is often followed by these companies, with money as the underlying asset. Their value chain position is *blockchain user*. Providers typically use an external blockchain infrastructure and its underlying consensus mechanism. They do not introduce additional technology. Providers generate revenue by charging fees for every transaction made into the network. Furthermore, they distribute their tokens. To increase the value of their tokens, they allow for the transfer of only their tokens within their offerings. An example is MakerDao, which aims to mitigate the lack of price stability of cryptocurrencies. They minimize volatility by linking their tokens to an existing asset, such as fiat currency. ETHLend, instead, shifts the attention to the loan-aspect of currency. They reduce costs for creditor and debtor by removing cross-border transaction costs.

In the end, the five patterns reveal that some blockchain applications provide a new *value proposition*, while others constitute *entirely new business models*. Therefore, blockchain technologies offer many possibilities to grow new businesses and create direct *threats of disruption* to traditional incumbents. Organizations that use conventional business models and propose themselves as an intermediary between two transaction parties must ask themselves how blockchain technologies may impact their value propositions. Firms can use these patterns, developed by researchers, to identify options for business model innovation toward blockchain and assess opportunities and barriers to integrating this technology in their current business model.

4.4. IMPLICATIONS FOR INCUMBENTS AND POTENTIAL NEW ENTRANTS

In considering potential innovation led by blockchain implementation, incumbents and startups typically pursue different goals: ***efficiency*** and ***disruption***, respectively. Large companies, according to consultants and entrepreneurs, struggle to understand blockchain and to envision potential ways to innovate through it. There are different causes behind this fact. First of all, the centralized nature of traditional firms makes it impossible for managers and executives to trust and appreciate the potential of decentralized models brought by the technology. Second, large organizations tend to favour efficiency gains over risky new approaches. Indeed, as emerged from the interviews conducted in the research of García Sáex et al (20202), *"what limits large organisations is that they are stuck in the traditional way of doing business"*. This is why most incumbents deny the disruptive potential of the technology and affirm that, a potential investment on blockchain technology would be essentially for efficiency purposes.

On the other side, startups seem to be much more interested in discovering new methods to *create* and *capture* value; for example, significant excitement was expressed about the potential for blockchain to unlock the data economy, access economy, and ultimately the circular economy. According to the entrepreneurs interviewed by García Sáex et al, *Blockchain could also provide users ownership over their data and eventually remuneration for its use*.

The fact that incumbents and startups fail to agree on the disruptive nature of blockchain is an issue because it reduces collaboration, encourages fragmentation, and ultimately hamper innovation. In practice, entrepreneurs face the danger of failing to achieve adequate market share, while incumbents face the risk of not to approaching such innovation on time thus being left behind to the point that they will be unable to catch up.

5 BLOCKCHAIN TECHNOLOGY IMPACT ON TWO-SIDED PLATFORMS DYNAMICS

In the last 15 years, thanks to the internet's dramatic reduction in communication and transaction costs, new platforms players have evolved their businesses delivering goods and services at previously unimaginable speeds and efficiency. These digital players (Amazon, Uber, Deliveroo) leveraged changes in the underlying technology to reshape pre-existing value chains and challenge traditional business models. They succeeded in doing so because they achieved a level of efficiency that their traditional competitors couldn't reach. Digital players were able to construct worldwide marketplaces where individuals, products, and services could be better matched leveraging the new wave of digitization made of computable algorithms and Cloud Computing. Something similar is happening thanks to the emergence of new technologies such as blockchain. While some established players will be able to use this opportunity to further scale their operations, others will be challenged by new entrants proposing entirely new approaches to value creation and value capture.

The potential of **blockchain technology** to disrupt existing markets has gained traction both for researchers and practitioners in recent years, thanks in part to the popular entrance of Bitcoin into the mainstream consumer space. In addition to its cryptocurrency applications, blockchain technology is also challenging the existing business models of firms operating in the modern platform economy by enabling a new type of **two-sided platform** (Trabucchi et al, 2019). Indeed, blockchain can be employed as a platform to create a peer-to-peer network that can authenticate transactions and on which applications and services can be created. Those kinds of architectures are called by researchers, blockchain-enabled platforms (García Sáez, M. I., 2020). These lead to substantial benefits in terms of *data security*, *trust*, *privacy*, and *decentralization*, as well as drastically *lowers intermediaries' expenses*.

However, the real disruptive factor of blockchain-enabled platforms goes beyond the main characteristics of transparency, immutability, security, traceability, reduced transaction costs and reinvent the way platform companies do business. Indeed, the "*monopoly-like pricing*" structure typical of platforms where the platform provider captures most of the value is renovated: in blockchain-enabled distributed platforms, the platform provider appears to share more value with the ecosystem of the platform participants.

Moreover, as explained by Parker (2016) in his research, blockchain technology enables a new type of platform architecture with a **distributed governance**. Rather of relying on a single entity to build and control the platform, these blockchain-enabled distributed platforms use internal joint revenues models to encourage open engagement of all the network actors through the so called "**token economy**". This has made it possible to provide similar digital platform service systems to those issued by a traditional platform provider, but in a distributed manner and with many *advantages*.

This chapter goes in dept in this topic and explains how blockchain technology affects the dynamics and features of two-sided platforms model. For this purpose, it's necessary to briefly recap the main features of blockchain technology that makes sense to consider when applied to the concept of platform:

- ◊ **Trustlessness**, which means that there is no need to trust a central authority, given the algorithmically enforced verification processes (consensus mechanisms). This technology acts as a trust enabler between the parties, thanks to the immutability of the data and the opportunity to rely on smart contracts.
- ◊ **Decentralization**: Since there is not a single source of data but instead many copies of the same, immutable truth stored across different nodes (network users), blockchain does not require the presence of a central node that operates as a validator of all the activities and transactions completed on the platform.
- ◊ **Token economy:** the possibility for the parties involved to hold and exchange token within the network as a medium of exchange.

The collaboration of various distinct sorts of actors is another important feature of blockchain-based distributed systems. This collaboration can be regarded as a multi-sided market, with some market participants serving as platform providers and others as platform users. For instance, in the Bitcoin platform, there are five market sides that can be separated individuated: users, application providers, miners, nodes, and platform developers.

5.1. THE NEW ROLE OF PLATFORM PROVIDER

Traditional two-sided platforms are defined by the presence of two group (usually buyers and suppliers), matched by a **platform provider**, that create and enjoy the effects of indirect network externalities. The platform provider is the central *intermediary* behind the platform, allowing transactions between two parties that would otherwise experience frictions in finding one another in the market. In doing so, the platform owner internalizes these network externalities while lowering transaction costs.

Blockchain-enabled platforms, or better saying platforms based on the blockchain technology, instead, are ecosystems on which other platforms work (Trabucchi et al, 2019). Essentially, they provide an architecture for building platforms, as well as a protocol that is not created for a single purpose but can be used for a variety of purposes (e.g., the blockchain protocol that is used for many different services or platforms on top of it).

Blockchain technology entails an important change in the *role of the platform provider* that links the two sides of a market. In particular, the role of platform provider is decoupled in *two different roles*: a **Blockchain provider** and a **Service provider** (that is the new platform provider). The former provides the underlying blockchain network, thus acting a *PaaS* provider. The latter provides a service, as a *facilitator*, on top of an existing network.

The fundamental mechanisms of two sided platforms are still in place for blockchain: the activity of matching buyers and sellers, as in any other traditional marketplaces. However, there are some *differences*. Indeed, the platform provider does not have to build up the platform and the overall structure on which the two sides interact since it acts just as a "service provider" that exploit an existing network, like Ethereum (Trabucchi et al, 2019).

Moreover, this change has consequences also in other functions and activities traditionally carried out by the platform owner such as designing proper value propositions for all parties involved, enabling a trustworthy environment between parties, and solving the chicken and egg paradox (Mazzella et al., 2016). The service provider still has to design a *proper value proposition* for all parties involved as in classic two-sided platforms, but it can disregard other *functions*. The trustworthy environment, for instance, that is an essential feature in two-sided platforms is now built into the blockchain, thanks to the intrinsic advantages of technicalities such as smart contracts and consensus mechanisms before mentioned. To give an example, in the case of a marketplace that leverages blockchain technology, it's possible to rely on precious instruments such as smart review, that ensures that a review is given by someone who really completed a transaction with that seller, and certified reputation scores that certifies the reputation of a user based upon his activities and past purchases.

To summarize, service providers still meet the criteria for being classified as two-sided platforms, with two groups of customers linked by network externalities and a central player that can internalize them. However, in platform enabled by blockchain, the **network externalities** are partially *internalized* by the service provider, which facilitates in getting both parties on board, and partially internalized by the blockchain provider, which established the original network. In this regard, the platform provider *transitions* from a **pure intermediary** to a **service enabler**.

5.2. ENHACING NETWORK EXTERNATLITIES: TOKENISATION

Consequences of token economy in blockchain-enabled platforms:

- ◊ *Possibility for the platform to thrive leveraging token externalities*
- ◊ *Increased user engagement and interest alignment for all the actors*
- ◊ *More possibility for users to internalize network effects*
- ◊ *Reduced frictions among sides*
- ◊ *Possibility to set a lock-in effect for platform owners*
- ◊ *New forms of value capture and creation: focus on sharing value*
- ◊ *Mitigation of chicken-and-eggs paradox*

Table 1. effects of token economy in blockchain-enabled platforms

The advent of smart contracts and non-native tokens in *Blockchain 2.0* paved the way for the **token economy** to flourish.

The role and the use of token is a crucial and interesting element that makes sense to discuss, when talking about blockchain enabled platform. Token is generally considered as "*units of value* and *rights* created by a blockchain-based network to self-govern its business model and allow users to interact with the entire ecosystem" (Lohmer and Lasch, 2020). In other terms, the token is the *foundation* of any blockchain-based platform representing, first of all, the operating currency that facilitate transaction within the network.

However, the process of **tokenization**, in which physical or digital assets are represented as tokens in a blockchain-based ecosystem, introduces also a new way to produce and collect value, through tokens, that extends beyond the exchange between buyers and sellers. This is the most significant advancement for a blockchain-based network.

This new opportunity to get value from tokens is linked with the concept of *positive* **network externalities** that are already present in every performant platform environment. These effects, called by researchers, as "***token-network effects***" or "token-based externalities" (Trabucchi et al, 2019), are direct network effect resulting from the distribution of tokens in a blockchain-enabled platform, which raises the value of the entire system (token incentives). More specifically, Token effects refer to the fact that there are huge incentives for users to be active part of the community by carrying out different activities that lead to the *welfare* of the whole platform. Indeed, users can provide various activities within the community and be *remunerated* for that through tokens. Activities could be transaction *verification*, *arbitration* of disputes, reviews writing and much more. Rewards could also come from the simple interaction with the platform: the higher the utilization in terms of number of transactions concluded, the higher the reward in tokens. To put it another way, they are similar to traditional usage incentives such as loyalty points, credits, provided by traditional platforms, but in form of token rewards.

At the basis of this process, there’s the link between the platform's network value and the tokens' monetary value. The **value of the tokens**, indeed, rises as the demand on them increases as a consequence of the platform grow (that in turn is strictly linked with the user engagement). In a nutshell, users carry out activities for the platform to earn tokens thus increasing the value of platform, which consequently lead token to increase their value and then the loop starts again. Moreover, this effect could also be engaged in the early stages of the platform to attract **early adopter** or investors. This is visible, for instance, during the *ICO* process where the tokens issued, are used to provide an intrinsic value to the platform by creating expectation about potential token re-appreciation.

All groups of platform players profit from *token revolution*: vendors, purchasers, core developers, third-party developers, investors, and service providers. **Re-appreciation** may persuade other users and sides to begin earning them, allowing the entire community to benefit from a better experience and services. *Therefore, the success of the business benefits every stakeholder or token holder on the network*. Consequently, tokens are what keep the entire platform **community** focused on the common aim of reinforcing and maintaining the business's health. For these reasons, they are particularly significant, and they can be considered a boosted version of the cross-side and same-side network effects that are still present in this blockchain-based platform.

To recap, new roles and responsibilities for users on the one hand, and a new role assumed by platform providers in terms of side interaction on the other, introduce novel forms of network effects. These new positive externalities, that could be considered both direct and indirect, are the result of two aspects:

- **Value of tokens**: in the sense that the greater is the demand for tokens, the more those become attractive thus increasing their utility, value and potential surplus.
- **Committed community**: Each token holder or users act to maximize the value of his investment (represented by token). This leads to an increased willingness to contribute to the platform and collaborate among the sides. In other words, the entire community is focused on keeping the token's value high.

As a result, *tokenization represents a new possibility of internalizing network effects for users*. In this case, the internalization of network effects is shared equally by all token holders and not held only by platform provider. This makes tokens become the main form of incentive upon the health of the platform. Users that hold tokens are aligned with the platform and its actors, since they are both interested in increasing its value and in creating a sustainable internal economy.

In the end, the fact that tokenization and token network effects can be leveraged by blockchain-based platforms represents **the most disrupting feature** compared to traditional platforms. The economy generated by token utilities and values within the platform is the primary source through which these platforms keep users and the whole community engaged, honest, responsible and loyal. Furthermore, if the platform assigns tokens voting rights, allowing token holders to actively participate in governance and strategic decisions, the platform utility is enhanced even more.

Moreover, using tokens both as a method of incentive for users and as a medium of payment to facilitate platform transactions, makes it possible to *align* the *objectives* of all actors of the platforms and eventually establish sustainable network effects over time.

5.3. TRUST AND GOVERNANCE

Users interacting and transacting on traditional platforms, such as Uber or Airbnb, rely on the platform owner's ability to set rules and processes to enable safe interactions. Trust in blockchain-enabled platforms is based on underlying protocols such as consensus mechanisms and transaction traceability. Trust in the intermediary is replaced with trust in the underlying code and consensus rules. For the first time in platform history, users can reach consensus and coordinate without relying on third-party intermediaries, enabling more granular and personalized services.

Trust and **governance** are therefore highly *interlinked*. Indeed, governance and security deficiencies undermine users' perception of blockchain-enabled platforms' truthfulness and legitimacy. Blockchain governance structures are frequently referred to decentralized autonomous organizations, or self-organizing systems. These "self-managed communities" reach consensus about the platform's core values, design a shared mission and develop common practices.

In the case of blockchain, governance establishes the rules and norms of interaction among all actors, determining access rights, transaction validity, conflict resolution, asset issuance, and tokenization. The agreed governance is implemented on-chain, for example, in consensus algorithms designed to be self-governing. Nonetheless, governance occurs off-chain as well. Even permissionless blockchains like Ethereum rely on an off-chain governance process to make decisions, upon, for instance, the proposals of new features for the network.

An effective governance system, according to Chen, Yan, and Pereira's (2021) mechanism design theory, should utilize individual incentives of the platforms participants to achieve desired outcomes. Platform owners, such as Amazon or Ebay, have exclusive governance power under a fully centralized governance framework, allowing them to egoistically determine governance procedures and outcomes. Platform participants (e.g., third-party developers and end users) may be disadvantaged and alienated if governance power is too concentrated in the hand of platform owners, as platform owners can prioritize their own interests above those of stakeholders.

Conversely, platform members that collectively and equally enjoy governance control in a decentralized governance structure, can expose their opinions, make decisions, and define goals through consensus mechanisms.

As a result, the degree of decentralization, which refers to the amount to which governance rights and power are shared between platform owners and platform participants, is an important feature of governance. Platform owners are more inclined to pursue overall welfare rather than their personal interests when they share governance control with platform participants, alleviating worries about power imbalances in digital platforms. There may be no platform owners at all, in extreme levels of decentralization where platform participants jointly have full governance control.

Decentralization allows digital platforms to increase the *power* of platform users while lowering the *authority* of platform owners. Platform users can influence, monitor, and engage with platform owners through decentralization, driving platform owners to pursue actions and outcomes that are more acceptable to everybody.

Digital platforms with decentralized governance are more likely to maximize the overall *welfare* of all participants rather than the residual profits of platform owners, potentially increasing incentives alignment and informational *efficiency* (Chen et al., 2021). Indeed, platform members can help increase the informational efficiency of governance processes by leveraging their own local information, knowledge, and initiative.

5.4. MITIGATION OF THE CHICKEN AND EGGS PARADOX

Users usually become interested in networks and platforms only once a significant number of them join, or when they achieve **critical mass**. The *bootstrapping* problem refers to the challenges that digital platforms face in attracting enough users thus becoming actually attractive and fully operative. Therefore, new blockchain-enabled platforms will have to deal with the so called "*chicken-and-egg paradox*" that affects all new platform businesses and it's typically prevalent in emerging markets. The *paradox*, that exists since the platform has no *intrinsic value* without both sides on board, could be solved by leveraging the new form of **network effects** discussed above, the *token* externalities. Indeed, tokens have the ability to solve the bootstrapping problem by offering more expectation of utility (the financial value) in the short period to early users, while the utility of being part of the platform is still low.

Blockchain adds a new type of value to platform, the *financial utility* for consumers and this actually represents the **mitigation** of the chicken and eggs problem. Indeed, by exploiting this concept, much before reaching the *critical mass* and finalizing the platform's launch, the platform provider carries out token distribution procedures to attract users on both sides.

The financial value is the value generated by the **re-appreciation** of token value as a result of the protocol diffusion. It's a mean by which early adopters of newborn blockchain-based networks are compensated for joining the platform despite their limited utility, thus for taking risks and dedicating their time, effort, and capital to a new platform.

This can be seen, for example, during the Initial Coin Offering (ICO), when tokens are given to the market as a new currency and serve as the first incentive for users to join the network despite the fact that the other side may not yet exist. As a result, tokens supply the missing intrinsic value to the system, alleviating the platform's "*ignition problem*" and speeding up the critical mass achievement.

ICOs make and hold users connected to the platform thanks to the fact every users are the first to be interested in the project's success. Indeed, since their purchased tokens, they are the first that have bet on the platform with positive expectations about the future value of the network to eventually profit on them. This means that by the time the platform is ready to debut, it may already have users who are incentivized in growing the network.

This method could also contribute to the creation of a value proposition. Indeed, while establishing a twofold value proposition for each side remains tough, tokens allow for a *"pre-market" phase* in which value can be offered using this new currency. This allows blockchain-based platforms to compete in a context where network effects are strongly in favor of established players.

This observation led to a better understanding of the blockchain-enabled platform network externalities and the role that tokens play in establishing, reinforcing, or dismantling such mechanisms (Trabucchi et al, 2019).

In the end, whereas the utility of being part of the platform increases once it fulfills the needs of all parties involved, the various sorts of economic agents are all **incentivized** to early join the platform by buying platform tokens since the financial utility has already a potential value, the value of potential re-appreciation. This is opposite to what happen in centralized platforms, where each side is waiting for a utility to emerge from a sufficiently large user base on the other side, and vice versa.

Emerging platforms can use tokens to compensate early token holders in comparison to the last one to arrive, who normally join once they perceive there's enough value in their side. Tokens show their effects when two sides meet for the first time, even *before* the conventional *cross-side effects* impact the platform (usually only once is fully operational). *So basically, users who decide to become early adopters, obtain financial benefits.*

5.5. COST OF NETWORK AND COST OF VERIFICATION REDUCTION

The ability to bootstrap and operate a blockchain-enabled platform is related to the cost of networking. As previously stated, a native token is frequently used to crowdfund platform development and create an incentive systems through which platform users are rewarded for contributing to the network. As a result, the cost of networking, that is strictly linked with the cost of verification, is seen as a scalability enabler for blockchain-enabled applications.

Taking into account the research conducted by Catalini et al (2020), I will define these two costs and how they are affected considering the context of blockchain-enabled platforms marketplaces.

The **cost of verification** relates to the ability to cheaply verify *transactions* that happen within the network.

Markets facilitate buyers and sellers to trade products and services. In order to be efficient, a market should allow participants to quickly check and audit transaction attributes, such as the parties' credentials and reputations, the nature of the assets transferred, and external information that are essential for the exchange. When a transaction happens online, one or more financial intermediaries play as a middleman, ensuring that the buyer, for instance, has sufficient funds. Intermediaries charge fees in exchange for their services, and they profit from their capacity to monitor all transactions in their marketplaces.

This is one of the expenses buyers and sellers face when they're note able to independently check all key transaction attributes. Additional expenses may arise because of the intermediary having access to transaction data (creating a privacy risk) and the ability to select which transactions to perform (a censorship risk). When intermediaries gain market power, these costs are amplified.

By allowing market players to verify transaction attributes without revealing the underlying information to an intermediary or third party, blockchain technology can lowering the cost of transaction verification and avoid information leakage. As a result, blockchain technology helps to reduce the cost of verification for various types of transactions.

Another issue that could increase verification costs is when, for example, a *dispute* arises during an exchange and transaction attributes must be validated through an audit. Such procedures are typically expensive, involve labor and cash, and may necessitate the use of a third party to arbitrate between the buyer and seller. Blockchain technology positively alters this flow by enabling for the costless authentication of digital information. Indeed, all the transaction attribute or information on the agents and items involved that is maintained on a distributed ledger, may be checked cheaper and in real time by any market player.

One of the main **consequences** of this verification cost reduction, is a **partial** *dilution* of intermediaries' and platform providers' market power. Indeed, reductions in the cost of verification enable part of activities traditionally performed by an intermediary, to be delivered by other networks' stakeholders (i.g users themselves). However, it's crucial to note that the cost of verification transaction attributes might be incredibly low only when dealing with *digital assets* that are *native* to a blockchain. Indeed, it is challenging to provide costless verification when entries on a shared ledger contain digital representations of offline identities, product (e.g, physical goods) or services, and related transactions. In this latter scenario, maintaining a trustworthy relationship between offline events and their online record significantly and negatively affect the reduction in the cost of verification.

The **cost of networking** relates to the costs of *launching*, *operating* and maintaining a platform (cost of bootstrapping and operating a network). A reduction of this cost is achieved by combining the reduction of verification costs with incentives aimed at rewarding transitions that are particularly valuable from a network perspective. More specifically, the lower cost of verification allows for the establishment of some transactions that rise the overall network welfare. Indeed, this positive effect could, for example, be leveraged to effectively reward participants for actions that increase the value of the network. For example, the protocol can be used to incentivize behavior that increases network effects (both in terms of users and applications), or ensures, for instance, that the network has enough resources to meet demand, and encourages saving or spending behavior.

Lowering the cost of verification is a necessary condition for lowering the cost of networking, but it is not sufficient. Indeed, implementations can benefit from the former without the latter. For instance, in the case of permissioned networks, these ones only take advantage of the reduction in the cost of verification, because these type of networks do not benefit of the advantages of token externalities that, as said before, create incentives for users to contribute in the activities of the network. This loss is due to the presence of intermediaries' control that can influence transactions and activities thus eliminating the prerequisites for enjoying the positive externalities brought by tokens. As a result, from an economics perspective, the network will operate under *constraints* similar to those of traditional digital platforms, and participants will have to trust the platform owner.

The main **consequence** of this reduction is that it allows to create sustainable **incentives** to keep the platform operate and scale. This positive effect is visible both in the first phase of bootstrapping and in a subsequent phase where is necessary to define the conditions under which participants can earn tokens for contributing resources to the network (these dynamics have been explained in the previous paragraphs).

Moreover, this type of reduction enables the creation of ecosystems where the benefits from network effects and shared digital infrastructure do not come at the cost of increased market power and data access for the platform operator. Indeed, it allow to exploit the new token externalities incentives without giving more power to intermediaries or platform owner, since the internalization of network effects is almost equally shared by all the users and not only by intermediaries/ platform owner as it happens in traditional platforms.

In the end, both cost reductions cause changes in how firms *create* and *capture value* within markets: it enables potential open source projects and startups to set up platforms where benefits from direct and indirect network effects are shared more democratically among participants (users, application developers, and investors), and no single entity has complete control over the underlying digital assets.

5.6. ROLE OF USERS

As illustrated before, the new role of the platform as service-provider, allows two-sided marketplaces to introduce new figures of users, which empower innovative relationships within the platform. The effect, which derives from the holding of tokens, makes user much more involved and responsible.

Indeed, as also highlighted by the interviews conducted by Trabucchi et al (2019), users, in blockchain-enabled platforms, move within a wider spectrum of *roles*. They can be in charge of many activities, that directly increase the health of the platform and thanks to which they can also be rewarded. This higher degree of responsibility significantly boosts the sense of community around the platform while reinforcing trust within and across sides.

In comparison to what happened in traditional two-sided platform where users usually have two main roles, one linked to the demand side, the other to the supply side, now users can embody different active roles in the transaction between various parties acting, for instance, as **arbiter**, **validator** or just as a **token holder**. A validator is a type of economic agent that verifies user-triggered transactions. An arbiter is a user who helps resolve disputes between two peers participating in a transaction. They are chosen by the system and operate as an unbiased transaction supervisor.

Moreover, there are other roles that each user can play, related to being token holders. These activities are related to taking *strategic decisions*, whereas the platform has also a distributed *open governance* that could be modified by the platform community itself.

Variables	Possible Values for Blockchain-Enabled Two-Sided Platforms				
Type of Users	Buyers (Demand Side)	Sellers (Supply Side)	*Validator*	*Arbiter*	*Token Holder*
Type of Relationship			*P2P*		
Platform Externalities	Same Side Effects		Indirect Externalities		*Token-based externalities*
Transaction Guarantees	*Smart reviews*		*Certified reputation system*		*Smart contracts*
Revenue Sources	Transaction fee from Side 1	Transaction fee from Side 2	Third Parties	*Token reselling*	*Technology rental*

Figure 10. Possible value for blockchain-enabled paltfrosm

Overall, this has two consequences for the platform ecosystem. On the one hand, it fosters the formation of **sense of community** around the platform offered by the provider, because users can play and contribute through different roles. On the other side, since individuals can take different roles at different times, being a buyer in one transaction and an arbiter in another, and get reward for that through tokens, the platform offers more power to those who actively participate in the service.

5.7. VALUE SHARING VS VALUE CAPTURE: THE IMPORTANCE OF THE COMMUNITY

As a consequence of the central role played by the token economy in blockchain-enabled platforms, we are looking at shift from a focus on value capture, typical of traditional platforms, to value sharing. Indeed, the main prerequisite through which platforms enabled by blockchain could become sustainable over time, is the presence of an **active community** of user that share the benefit coming from their activities. In turn, as seen before, the existence of a high level of community's *commitment* is strictly related to the presence of positive token externalities that strengthen network dynamics, increasing trust among sides, while giving users significantly more responsibilities.

Today the most successful digital platforms have found their competitive advantage in the **community building** (e.g., Amazon and Airbnb). Indeed, no hub firms will maintain an advantage over the long term if it disregards the well-being of its users (Iansiti et al, 2017).

In the case of blockchain-enabled platform this aspect is even stronger. Indeed, community is necessary not only in the first phase to *populate* the platform but also to keep the network **operative** and eventually scale it. However, while big traditional platform companies claim for a disproportionate stake of the value created within their network (Iansiti et al, 2017), blockchain-enabled platforms share this value in order to set common *incentives* for all the stakeholders.

One of the first goals of a blockchain-enabled platform is to *engage the community*, because the sooner the community is engaged, the sooner it begins to play a central role in the platform's growth and development. In fact, once the platform is operational, every user or member of the community can begin to accumulate additional tokens in a variety of ways, including direct usage of the platform, thus creating a **positive loop** and ultimately increasing the value of tokens: the higher the utilization in terms of number of transactions completed or meaningful interactions, the higher the reward in tokens.

In the end, the presence of the platform is just at the margins of the ecosystem, while *community is at the center* and revolves around the **role of tokens**. *Blockchain-enabled platforms are characterized by a heavy dependency on the platform's community*, where users embed different roles and activities thus leveraging both sides' willingness to execute tasks and so contribute to the business's grow. Once again, the crucial point is that all sides are interested in rewards and incentives, as well as the overall health of the platform.

5.8. POTENTIAL DISRUPTION OF BLOCKAHIN-ENABLED PLATFORMS

In order to analyze the *disruptive potential* of blockchain-based platforms (BBP), I will refer to the research conducted by Guido Perscheid (2021). He tried to answer the following question by adopting Christensen's theory of disruptive innovation:

Can blockchain, when applied to platforms, be considered a disruptive innovation, and if so, which type of disruptive innovation is the most likely?

According to Christensen's theory of disruptive innovation, the disruptive potential of a technology can be classified along with the following three steps:

1. *First*, the analysis of whether a technology-based product or service is to be classified as an innovation.
2. *Second*, the analysis of whether an innovation is to be regarded as a sustaining or disruptive one.
3. *Third*, Christensen further specified the field of disruptive innovation by distinguishing between low-end- and new market disruption. low-end disruption is characterized by addressing existing low-end customer segments, whereas new market disruption addresses new value networks by attracting customers who would not have used the product or service without the technological innovation

Appling these 3 steps to blockchain-based platforms lead to these results:

Step 1. To represent an *innovative technology-driven approach*, DP have to provide a change in technology through which "an organization transforms labor, capital, materials, and information into products and services of greater value" (Christensen., 2017). Using blockchain technology together with smart contracts, DP provide a new approach through which the "value" of products and services is enhanced. Consequently, applying smart contracts on the blockchain represents an **innovation** that has not been offered before.

Step 2. According to Christensen (2017), *sustaining innovation* creates better products or services that can outperform incumbent market-leading companies' products using innovative improvements for high-end customers. Instead, *disruptive innovation* as a process where a smaller company can successfully challenge an established incumbent company by introducing technology-driven products and services that are not as good as currently available products but offer other benefits for low-end customers.

Based on the findings of Guido Perscheid (2021), Blockchain can be categorized as a **potentially disruptive innovation**. The reasons are: 1) Most platform based on blockchain technology, are relatively small projects being developed by motivated, skilled developers from startups 2) Services offered, because still in an early stage of their development, cannot compete with their centralized counterparts in terms of quality 3) blockchain-based platforms introduce a new form of a technology-driven platform (blockchain) that offer benefits their centralized counterparts do not (privacy, anonymity, reduction of fees etc..) 4) blockchain-based platforms offer a different value proposition than the market-leading centralized platforms allowing them to address "low-end value networks", particularly in niche markets

Step 3. According to Christensen (2017), *low-end disruption* is characterized by addressing existing low-end customer segments, whereas *new market disruption* creates new target markets by attracting customers who would not have used the product or service without the technological innovation.

Following this definition, blockchain should be classified as "**low-end disruption**" because the implementation and the use of blockchain-based platform remains at this point more complicated, in terms of usability, than its centralized counterpart due to the high level of technological knowledge and resources needed by users. Therefore, most users of these new platforms are tech-savvy people who switch from existing centralized platforms because they were just interested in the new technology and the benefits associated with it or due to convictions.

So, in the end, the result is that blockchain, when applied to platform BM, is characterized as ***a potential low-end disruptive innovation*** in the context of platform economy. DP, represent a new form of platform-based business models, using a new technological approach, blockchain technology, and smart contracts, thereby serving primarily low-end customers that are first interested in the new functionalities and in the resulting benefits of the blockchain technology as well as in the ideological motivation to redistribute the produced value by cutting out the middlemen. However, besides the categorization as potential "low-end disruption", it is also conceivable that by continuously evolving the existing BM enabled by blockchain and smart contracts, may also encourage new customers to use blockchain-enabled platforms, in the sense of a "*new-market disruption*", thus enhancing blockchain disruptive potential.

Moreover, since blockchain-based platforms actively involve their users in the development of the platform (Perscheid et al., 2020), they can continuously adjust their offers to the customer's needs. According to Christensen's theory of disruptive innovation, this ongoing improvement of the platform's value proposition, enables platforms to acquire customers more rapidly, including customers from high-end value networks. In this case, the self-reinforcing mechanisms of the network externalities (as seen before) would lead to rapid growth of the platform, thereby potentially outperforming the incumbent platforms, thus becoming a serious threat to their future existence.

Given these insights, we no longer need to ask ourselves whether blockchain have disruptive potential, but rather, whether the established traditional platforms have the means to defeat this new form of platforms. Consequently, with the increasing popularity and use of cryptocurrencies and the ongoing application of blockchain technology into various business fields, it can be assumed that blockchain have the potential to become a severe **threat** to the leading centralized platforms, disrupting the *platform economy*.

5.8.1. IMPLICATIONS

All previous discussions are a clear example of how blockchain technology can support platforms' growth and trigger new interesting mechanisms upon two-sided markets. In particular, even if the disruptive character of the technology is confirmed (Perscheid., 2021), according to Trabucchi et al (2019), it's reasonable saying that *blockchain does not completely disrupt the model of two-sided platforms but may actually **enhance** it*. Indeed, most of the dynamics that characterizes the two-sided platform model are changed or even extended as in the case of same-side and cross-side network effects and the relationships among sides.

In any case, firms operating in the modern platform economy, in order to keep their position in the market, should be aware of the *potential changes* brought by blockchain and should understand whether and how it makes sense to implement this technology within their business models and enjoy the advantages. If they are not be able to do so, they run the risk of becoming victims of the "***innovator's dilemma***" that once enabled them to disrupt entire industries.

The table below recaps the main impact of blockchain technology on two-sided platforms model:

Two-sided platforms dynamics	**Impacts of blockchain technology**	**Definition of the impact**
Chicken and eggs problem	*Extended*	Token economy defines new ways to solve the chicken-and eggs and critical mass reaching problem leveraging

		token financial utility (ICO, token incentives).
User roles	*Extended*	New roles and responsibilities can be assigned to users by platform providers (validator, arbiter ecc..)
Platform provider role	*Changed*	The role of platform provider is disentangled in two different roles: blockchain provider of PaaS and service provider that design a service upon the underlying protocol
Sides relationship	*Extended*	All the sides are aligned by common interest in keeping high the value and utility of tokens they hold
Platform governance structure	*Changed*	New models of governance can be introduced upon decentralized platform (full decentralization vs partial decentralization)
Network effects	*Extended*	Token network effects arise and boost the traditional same-side and cross-side effects

Table 2. Impacts of blockchain on two-sided platforms

6 MARKETPLACES ENABLED BY BLOCKCHAIN TECHNOLOGY

As illustrated in the previous chapters, blockchain technology is increasingly being promoted as a generic technology that can be adopted for a wide range of use cases.

According to Iansiti and Lakhani (2017), it has the potential to lay the groundwork for the development of unprecedent business models. Among them, those BMs that eliminate *intermediaries* within an ecosystem of actors are particularly interesting from a business and innovation perspective.

After analyzing how blockchain technology impacts the dynamics of two-sided platforms and introducing the concept of blockchain-enabled platform with its innovative *potential usages*, to narrow the research object of this report and give some real case examples, I will focus on one of the many potential applications field for this kind of platform architecture: **the marketplaces context**.

Even if blockchain technologies are originally designed to serve as a "record" for transaction from a technical point of view, they are frequently depicted as platforms or technologies that enable transactions. What began as a *cryptoanarchist fantasy* is now on the verge of destroying traditional commerce (Mik., 2018). Indeed, researchers claim that blockchain technology's *decentralized nature* allow to disintermediate commercial exchanges, lower transaction costs, and empower both sellers and buyers.

The capacity to safely track transaction attributes, settle trades, and enforce contracts across a wide range of digital assets, is what makes blockchain suitable to marketplace BM. The ownership of currency, digital content, intellectual property, information, contracts, financial, and physical assets can all be represented by entries on a distributed ledger. As a result, open source projects and startups interested in establishing platforms for the trade of different goods, have started to adopt this new technology.

Amazon and eBay have built efficient online markets that are backed by sophisticated technical infrastructures and a complicated net of legal agreements that govern their use. Despite their popularity, they are frequently accused of being "centralized" since they are managed by a single entity that regulates who can trade on them and prescribes what can be traded. For many, such centralization and intermediation go against the spirit of the Internet, which was supposed to be an open, *egalitarian* network that allowed for new economic structures and direct forms of collaboration.

Blockchain, it is said, allows for the establishment of more advanced, decentralized transacting platforms. This superior technology, according to reports, enables complete reliance on code, by eliminating the need for any centralized authority to control the use and operations of such platforms. Moreover, as previously illustrated, provide many advantages to all participants, including *security, trust, privacy, lower transaction costs*, and transaction integrity. It's not without reasons that blockchain is frequently cited as a primary example of *decentralized web* or *web3*. The underlying idea, behind this paradigm, is to democratize the web by utilizing technologies, like blockchain, that leverage cryptographically secure methods to empower individual sovereignty. The whole ecosystem, data usages, and interaction rules in web3 are not maintained and controlled by the same few firms or organizations that currently control the internet. Instead, ecosystems, are regulated and governed by their users, run on a distributed network structure, and based on open protocols.

In this chapter I will introduce decentralized marketplaces comparing them with traditional ones. Moreover, I will stress the concept of **decentralization** as the main challenge of such markets presenting some alternatives to the full decentralization framework and I will investigate the role of market operators in this new context.

6.1. DEFINITION OF DECENTRALIZED MARKETPLACE

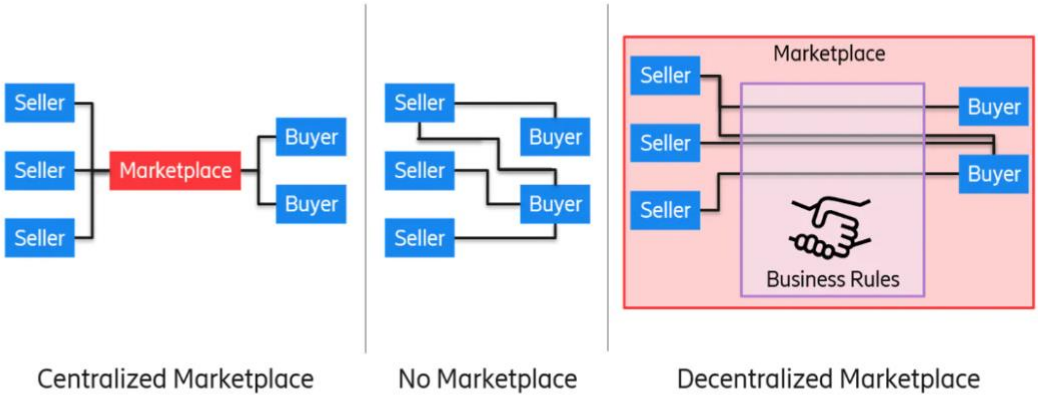

Figure 11. Different types of interactions between buyers and sellers

Before proceeding with the illustration, it is helpful to give a brief definition of what is meant by **decentralized marketplace**, according to literature. Decentralized marketplaces represent the application of blockchain technology to transactional *two-sided markets*, also known as marketplaces (Subramanian, 2018).

A decentralized marketplace is built on blockchain technology and allows sellers and buyers to trade with each other while eliminating middlemen intermediation.

Data storage is not centralized and information are, generally, readable by all network's members. There is not a single authority and no external third party is required for validating transactions and activities.

The *rationale* behind this definition is that once it is possible to *trust the code* underlying a marketplace than contains rules and regulations, then it is no longer necessary to trust centralized operators or rely on any traditional institutions (Internet of trust). In decentralized marketplaces, the trust in the code and its validity is ensured by the blockchain technology itself. The ***vision*** is of a pure free market without any intermediary in control.

Below, some key characteristics of blockchain, that lay the ground for decentralized marketplaces, are reported:

Data security and persistence are guaranteed. There are no possibilities to tamper the chain or erase transaction traces after they've been recorded on blockchain ledgers. More specifically, data manipulation, which is technically achievable by controlling the majority of network nodes, becomes nearly impossible because it is prohibitively expensive. Moreover, all market transactions involving an asset or service are recorded on a publicly accessible and verifiable ledger.

Payments are made directly between the parties and intermediation of any type is avoided. As a result, transaction fees are relatively minimal, and payment processing time is nearly instantaneous (compared to some, but not all, traditional payments such as bank transfer). Using cryptocurrency and token-based gateways allows to provide a smooth and frictionless payment experience for customers. Plus, using algorithmic consensus and smart contracts, platform bureaucracy is reduced.

Transparency of governance is ensured by the usage of smart contracts. What happens on the platform is exactly what has been coded into the smart contract. As a result, users deal with codes rather than authorities, organizations, or any other hierarchical structure, thus creating a transparent, automatic, and self-enforcing processes.

Privacy and anonymity are stronger because platforms require very few information to open a blockchain wallet and start operating inside the ecosystem. Furthermore, the true identity of marketplace participants may be hidden from other participants and because the blockchain automatically encrypts transactions, transaction information is hidden from the network as well.

6.2. DECENTRALIZED VS CENTRALIZED MARKETPLACES

Marketplaces, which are a type of transactional two-sided market, make it easier for people and businesses to trade services, goods, and information. They are vital to our economy because they allow for the exchange of value on a local and global scale, as well as the matching of different market sides (buyers and sellers). Electronic markets, which use Internet technology to exchange products and services, account for a significant portion of all trades. On *electronic marketplaces*, users trade with users with whom they have never previously interacted. Amazon and eBay are famous examples of large-scale electronic marketplaces that *facilitate the exchange of goods between buyers and sellers*. Companies in the sharing economy, such as Uber and Airbnb, have broadened the impact of e-commerce, in recent decades, by providing global marketplaces for the sharing of personal resources, such as vehicles and houses, with strangers. These e-commerce platforms tend to **internalize** a large portion of the profit derived from **network effects** (the incremental value added by each new participant), thus gaining, over time, a monopolistic position and tremendous market power that allow them to have full control of the entire marketplace.

The traditional method for creating electronic marketplaces is to set up a centralized infrastructure that is wholly administered and overseen by a reputable market operator. This market operator performs the necessary **functions** of matching buyers and sellers, facilitating the exchange of information about products (product listings), and enabling payment and transaction processes (providing payment services).

Also, the market operator frequently serves as a *trusted intermediary* between buyers and sellers, utilizing its middle position to resolve potential trader conflicts. Uber, for example, verifies that its drivers are qualified to provide safe services to customers, mediates in the event of a dispute, and handles all passenger payments. The ability to function as trusted intermediaries is at the heart of electronic markets, and their services help to ensure that a transaction between two buyers and sellers, who may or may not trust each other, goes smoothly. Market operators generally charge users transaction fees in exchange for their services. As a result, despite their important role, trustworthy middlemen raise trade costs because they are typically profit-driven.

Furthermore, using an intermediary always requires some level of *exposure* to a third party, which increases the risk of personal information about users being reused outside of the original contractual arrangement. In addition, because the majority of users' actions in this environment are digitized, keeping data secure has become more difficult, and information leaking has become more common. Theft of social security numbers and credit card information are classic examples, as well as the leasing of customer data to advertisers. The 2014 eBay data breach, for example, put the personal information of 145 million users at risk.

All these aspects together with the huge market power owned by these platform companies, created a huge interest in trying to *remove* these “trusted” intermediaries from the trading process.

Technological innovation, particularly blockchain technology, call into question the need for both authoritative market operators and trusted intermediaries, giving rise to the concept of disintermediation.

The concept of disintermediation, intended as the elimination or reduction of the need for trusted intermediaries, is closely related to the process of decentralization, in which authority held by a single entity is distributed across multiple entities. A growing amount of research are being conducted to disintermediate various aspects of electronic marketplaces thus replacing centralized components with decentralized solutions. Blockchain's contribution to this effort is to substitute trust in intermediaries with cryptographic mechanisms and delegate activities away from a central authority. Overall, the use of cryptography and smart contracts to create an on-chain decentralized marketplace, eliminates the need for a large central entity to coordinate marketplace functions.

To better understand the concept of decentralized marketplace, I will propose a *comparison* between these new types of marketplaces and traditional ones, based on the main generic functions of marketplaces (Subramanian., 2018) showed in the table below:

Primary Market Function	**Sub-Functions**
Matching buyers and sellers	• Determination of Product Offerings • Searching • Price Discovery
Facilitation of Transaction	• Logistics • Settlement • Trust
Institutional Infrastructure	• Legal • Regulatory

Table 3. Different functions and sub functions of marketplaces

6.2.1. CENTRALIZED MARKETPLACES

The following are the primary marketplace functions of traditional centralized marketplaces:

Matching sellers and buyers function. E-marketplaces prosper because of network effect generated when they allow buyers, sellers, and eventually third parties to trade with one another. Matching can be facilitated by either a seller-led promotion or a customer-led search. Buyers benefit from lower search costs, while suppliers profit from free product listings and shared inventory and delivery costs. E-marketplaces enable global reach (buyers can be found anywhere) and transaction immediacy (buyers and sellers can trade at any time). In addition to lowering costs, markets also boost revenues by influencing customers' buying choices through product recommendations, bundling, and other manipulations.

One of the greatest limitations, regarding this function, is that in today's e-marketplaces, matching market features is not performed efficiently. For example, price fluctuations driven by algorithms can make certain goods more expensive online compared to equivalent offerings offered in physical stores. Furthermore, the actions of sellers and buyers influence operators' decisions about the marketplace and vice versa; for example, if the marketplace's owners decide to stop accepting certain payment methods, market participants must either change their payment method or stop transacting on the platform. In the same way, traders would gain or lose the capacity to buy or sell in the marketplaces, if the platform's owners decided to charge different prices for similar products across client segments based on profit maximization algorithms.

Consider how Uber determines ridesharing prices using proprietary algorithms that may or may not account for an individual driver's actual profit margin. As a result, while the customer benefits from lower charges when compared to a traditional taxi service, the drivers suffer of the platform's decreased pricing. This happened when a monopolistic platform owner leverages network effects just to maximize its own profit without worrying about enhancing benefits for all the sides involved.

Facilitating transactions function. A marketplace enables the exchange of value between buyers and sellers by facilitating transactions. On the platform, the buyer pays the seller, and the seller transfers the physical good or service to the buyer. Each transaction has a variable cost due to the verification services provided by banks, credit institutions, logistics providers, and other intermediaries.

A limit for centralized marketplace, regarding transactional function, is providing trust and security while ensuring privacy at the same time.

In carrying out transactions, trust plays a fundamental role in any kind of transaction between a buyer and a seller. That's why, usually, there are marketplace-controlled "ratings and reviews" systems that inform users about the reputation of sellers.

However, no reputation system is failsafe, but instead could be altered by spam and fake ratings and reviews. As a result, reputation systems can be a big cause of concerns that undermines trust in the system. To mitigate this risk, markets reveal the full identities of both the seller and the buyer, as well as transaction data to one another and also to others actors on the platform. However, such information can be used for a variety of malicious purposes, such as feeding customization algorithms to infer a user's purchasing behaviour or target future promotions. Personal information is also used by other marketplace actors, such as credit-validation services, to validate payments. As a result, personal data, such as addresses, Social Security numbers, and credit card numbers, become a vulnerable target for hackers. A single hack on the database that stores personal data results in tremendous damages, including client trust in the platform. In recent years, every online marketplace (such as Amazon, eBay, Sony) has experienced at least one data breach scandal.

Other limits include circumstances in which transaction costs exceed the actual sale price, payment mode restrictions, or network infrastructure issues. These disadvantages may lead, for instance, to frictions caused by currency-transfer restrictions during foreign transactions.

Facilitating institutional infrastructure function. Contracts are usually respected by participants in e-marketplaces using mechanisms like click-wrap, shrink-wrap, and web-wrap enforcement. Through the exchange of payment, goods or services, e-marketplaces authenticate transactions and enable automatic contract enforcement. In the same way, e-marketplaces safeguard participants' intellectual property by enforcing copyright laws and prohibiting the sale of counterfeit items, thus preserving the brand value of the commodities being sold.

6.2.2. DECENTRALIZED MARKETPLACES

In a decentralized marketplace, the firm or the marketplace operator responsible for ensuring all the marketplace functions above illustrated, is replaced by a network of nodes, each independently and concurrently accomplishing the same functionality as that of a centralized marketplace but in an improved way:

Matching buyers and sellers function. Decentralized marketplaces can grant unaltered and not manipulated "access" to information, such as listings. Individual sellers are in charge of creating product listings, which are subsequently redundantly distributed over the network. When search results about listed goods posted by sellers remain intact, information transfers become significantly more reliably. In the same way, price-altering and preference-altering algorithms can also be disabled or adjusted by individual sellers, so listing problems are reduced by design.

Transactions function. Because intermediaries' gateways are not used, transaction costs are kept low. Buyers pay sellers directly, and the network uses consensus processes to verify payment transactions. Consider a traditional e-commerce payment process as an example of efficiency. When a buyer presses the checkout button, several systems, such as payment and credit-card networks, charge a fee. In a decentralized e-marketplace, instead, traders transact securely and directly with one another, and the network of nodes validates and records each transaction charging much lower fees.

Transactions are safer here since they can't be tampered with by anyone in the marketplace. Cyberattacks on both individual accounts and transactions are discouraged by transactional anonymity and privacy. Microtransactions like tipping and micropayments are also made possible. Disputes concerning transactions are normally resolved by neutral third party. As a result, sellers' and buyers' reputations are handled independently of the marketplace. Returning items and payments is handled through the mediation of a broker using methods including multi-signature contracts, notarization, and arbitration.

Institutional infrastructure function. Contract enforcement options such as fully automated smart contracts, partial automation, or manual enforcement ensure that, inevitably, all parties involved in a transaction follow the agreed-upon terms.

According to literature, there are also other *novelties* and advantages brought by decentralized marketplaces compared to traditional. However, these additional features are not always implemented but instead depends on the specific characteristics designed by the decentralized market considered. Among them, the most significant are the following:

- **Less market power for marketplace operators**: there's a mitigation of lock-in effect and a decrease of switching costs that are typical of centralized marketplaces due to the fact sellers do not have to pay any subscription for their listings.
- **No more single point of failure**: this is a consequence of the distributed architecture of the ledger. Even if individual servers break down, the overall market is not affected. In this way, the risk of failure or hacking tremendously decreased.
- **Low Fees, Cheap Prices**: The cost of selling products for sellers is drastically lower than the fees you would have to pay to sell through any of the major alternatives (such as Amazon). Lower fees for sellers mean that savings can be passed on to buyers in the form of cheaper prices.
- **Reduction in the censorship risk**: Traditional marketplaces retain full control over who can sell or buy and what can be traded. Instead, decentralized services offer a truly free market for buyers and sellers to trade as they wish.
- **No Chargeback Fraud**: Chargeback fraud is when somebody buys an item using a credit card or Paypal. After the receive the item they contact their credit card company and order them to reverse the payment, fraudulently claiming that the item was never delivered. This is a massive problem for internet

retailers because there is very little they can do to defend themselves against it. As a result this pushes up the price of products, as sellers must factor this extra cost into their pricing. By harnessing the power of digital currency, decentralized marketplaces are able to eliminate chargeback fraud.

- **Flexible Terms**: When you decide to sell an item through a central website, you must accept the terms and conditions laid out by them. These cover a wide range of areas including things like guarantees and customer refunds. Decentralized services allow each seller to specify their own terms, and buyers to shop around for the best deal and not just the cheapest.
- **Users retain control of their personal information**: When you join an online marketplace site you have to provide personal information to meet the requirements of that website. This personal information together with your purchase's history, can be used as a source of profit for marketplace operators selling these data to third party or using them for their own interests. In decentralized marketplace, there's no more data monarchy to the benefit of operators. Indeed, users can choose how much information to share and can potentially decide to sell their data by themselves to third parties thus making profit instead of operators.
- **Verified reviews**: Decentralized marketplace, by leveraging cryptographic mechanisms and smart contracts, allow only authenticated review to be post thus limiting fake and manipulated reviews typical of traditional marketplaces.

In the end, decentralization challenges the *paradigms* of today's traditional markets, in which a single major platform owner has complete control over every part of a transaction, from product listings to price discovery, product search, logistics, and customer experience. Decentralized markets built on the blockchain are a potential alternative to traditional firm-controlled marketplaces, with benefits derived from how decentralization supports and facilitates marketplace activities.

All market players benefit from decentralized markets, which include *security, transparent information sharing, privacy and transaction integrity*. Most important, blockchain, eliminates the requirement for a central authority to approve transactions, resulting in several **efficiencies**. For example, transaction costs associated with contract enforcement can be lowered or removed when the network validates the transaction.

The tables below recap the main *characteristics* and *benefits* of **decentralized marketplaces**:

Marketplace Feature	**Blockchain-Based Decentralized Marketplace**	**Traditional E-Marketplace**
Trust through contract enforcement	Distributed validation, including proof-of-work mechanism or proof-of-stake mechanisms. The network enforces the contracts between seller and buyers. The network validates reputation ratings, including reviews and feedback mechanisms.	Third parties (such as banks, certifying authorities, transfer systems or other forms of contractual mechanism). Usually controlled by the firm. Potential for significant alteration.
Transaction time	Can be instantaneous due to fast network validation. Delays can be mitigated using proof-of-stake/work consensus algorithms	Letter of credit or acceptance of credits, credit transfer that can take long time.
Value	The network can reward participants with tokens or by accepting third-party tokens	Banking systems (such as national exchanges, currency, and underwriters).
Privacy and security	Identity is not disclosed on the network. Tracking transactions can be facilitated, though with difficulty. Transactions details can be hidden behind layers of encryption. Cost of tampering	Identity fully disclosed in the marketplace. As secure as the network’s components.

	with the network's validation mechanism is high.	

Table 4. Comparison between traditional centralized and decentralized marketplaces

Main benefits of Decentralized Marketplaces
◊ Less transaction costs thus less fees for sellers thus lower prices for buyers
◊ Less power in the hands of marketplace owner
◊ Exploitation of internal token economy to create network contribution incentives
◊ More anonymity, safety, security, transparency and privacy of data
◊ Empowerment of users
◊ No more need of trust due to the "trustlessness" property of the marketplace
◊ More alignment between all the actors
◊ No more single point of failure risk
◊ Potential self-governing governance based on trustlessness
◊ Unbiased product information when matching buyers and sellers
◊ Potential new entrants (as dec. marketplaces lower entry barriers preventing monopolies or collusion among few players)

Table 5. Main benefits of implementing Decentralized Marketplaces

6.3. UNDERLYING CRITICALITIES

Even if decentralized marketplaces seem to be the final solution to the monopolistic and concentrated power of colossal firms that govern marketplaces, there are many **criticalities** that still need to be solved.

According to the interviews conducted by García Sáez (2020) to some leaders in blockchain and platform strategy, including top executives and entrepreneurs, those criticalities are related to four stress factors:

1. The **first** stress factor is related to the **technological development** and implementation of blockchain technology. Indeed, when compared to a centralized database, blockchain technology is still inefficient in data verification. Each transaction has a time delay, and blockchains can only process a fraction of the transactions per second elaborated by other systems. Ethereum, for instance, can process 20 transactions per second on average, while VISA can process over 24,000 transactions per second. Bitcoin has a transaction rate of roughly seven per second. This gap is essentially caused by the latency between nodes and by the time needed for the consensus processes to be performed.

   Furthermore, to make decentralized platforms more effective, the exchange procedure between fiat currency and cryptocurrencies must be enhanced. Also, installation costs are still high: customer-specific blockchain applications necessitate expensive expert developers and time-consuming integration activities. In addition to those aspects, blockchain has relatively limited computational capabilities. However, the fact that this technology is pretty recent, explains the existing inefficiencies. As technology advances, it is usual for inventions to become significantly more efficient in their use.

2. The **second** factor regards the market **speculation** about token value increase. Tokens may be traded for a variety of currencies, including FIAT and other cryptocurrencies. This entails that each token has a monetary value. This monetary value should, in principle, represent the token's utility (as illustrated in the previous chapters). The monetary value of these tokens, however, is determined by the value of Bitcoin (and other cryptos). This means that a decentralized marketplace platform might create a token system that is valuable to its customers, but the monetary worth isn't solely determined by the token's utility. Indeed, the significant volatility of the cryptocurrencies used to trade tokens has an impact on token value. As a result, the financial incentive may be

ineffective in stimulating network effects and users would not be motivated to participate in valuable activities if they did not receive a reward, because the token may be worthless.

3. The **third** stress factor is related to the **trust** that *society* put in blockchain. Indeed, the blockchain technology and its applications are unfamiliar to most people. It's tough to say to what extent society will begin to accept blockchain technology applications. The sophistication of blockchain technology, as well as the fluctuating value of cryptocurrencies, contribute to a lack of public faith in the system. Before decentralized markets models can undermine centralized business models, trust must be developed. Right now, existing decentralized marketplace solutions are aimed at tech-savvy customers, and the benefits are not yet well understood. In this view, the true barrier to mainstream adoption of blockchain technology is the lack of a critical mass of users.
4. The **last** stress factor regards the establishing of **regulations** on blockchain technology by policymakers. Regulation imposes limits that must be considered, particularly for innovative tools such as smart contracts. The changing regulatory environment create uncertainty around decentralized BM in terms of feasibility and compliance. Many nations are drafting some blockchain technology regulations, but regulators are unable to keep up with the rapid growth of the technology. Furthermore, it might be claimed that a lack of understanding of blockchain technology contributes to a regulatory environment that is too restrictive.

There are also *two additional criticalities* related to the concept of decentralized marketplaces that are relevant for the aim of this report:

6.3.1. THE CONCEPT OF DECENTRALIZATION

So far in this analysis, I referred to decentralized marketplaces as marketplaces where there’s absolutely no need of any intermediaries or entity controlling and/or operating the platform since, by relying on the trustlessness feature of blockchain, it is possible to trust the code of blockchain itself. However, according to Eliza Mik in her research (2018), an effective full decentralization is the most difficult aspect to put in practice when implementing decentralized marketplaces. Below some reasons of this statement.

First of all because **the concept of decentralization** is *nuanced* and often more *ideological* than practical. For instance, decentralization is not necessarily related to the *concept of control.* One could have a decentralized network that is controlled by a single entity. But even if those aspects are related, in full decentralized marketplaces there's no space for users' decisions or interventions since everything is already set by the automated execution of a consensus algorithm. Contrary to what is implied by the blockchain ideology, the decentralization of control does not automatically translate in the ability, for users, to make actual decisions about the system and how it operates. Indeed, consensus algorithms does not reflect the actual users **agreement**: distributed consensus is generally unrelated to any formalized governance process. To better explain the reasoning: If there is no clear mechanisms for improving decentralized consensus algorithms and general rules, then these appear to be of *low utility*. After all, it is *unrealistic* to expect any blockchain to be perfect and flawless "at genesis" and, unlike all other technologies, invulnerable to the need for future updates.

Second, as a consequence of what said before, the ability to *trust* the *code* implies the need to **trust** the person that created the code. So, the ***trustlessness*** of the blockchain depends on the ***trustworthiness*** of the coders (Mik, 2018), to the point that we could ironically state that decentralized marketplaces replace traditional intermediaries with a new type of intermediary: *coders*.

Third, practically speaking, because there is no single entity that controls or is *accountable* for the modalities that the marketplace operates in full decentralized models, in the event of a dispute over transaction failures or technical problems, there is no repercussion against the platform operators because, theoretically, the platform is operated by all of its users.

This could be a huge problem. Of course, there exist solution where the role of solving the disputes is given to external parties (Open Bazaar) but in this way, the concept of an actual "full decentralization" is hampered.

Finally, a **lack of centralized control** leads to a lack of governance or, alternatively, the formation of informal or subtle control systems. Indeed, fully decentralized marketplaces by placing absolute reliance on the rules embodied code, suffer from an inherent lack of governance because there's no one that officially create or modify the rules governing the platform. It is unclear who makes those rules and who has the authority to change them. On the other hand, a formalized governance process must exist to maintain and improve the code. This seems of particular importance for a technology enabling commercial exchanges and transfers of value. However, this would imply someone who is in control of this process, even if decisions come from users. As a consequence, the concept of full decentralization is hampered again and from an ideological perspective, it contradicts the ethos of decentralization and "trustlessness."

In the end, blockchains that lack formalized governance system indirectly *favour opaque power structures* and prevent blockchain-based systems from adopting new regulations that the market demands. Consider a scenario in which Amazon or eBay's technology hasn't improved since the late 1990s, or if either corporation is unable to react to regulators' and law enforcement requirements. This would make the marketplaces not sustainable. This criticality usually applies to more public ledgers, while private ledgers are more commonly equipped with governance systems and explicitly presume that the system will be modified and improved in the future.

6.3.2. PHYSICAL VS DIGITAL GOODS

Another criticality in the context decentralized marketplaces, regards the necessary *distinction* between **the nature of goods traded**, whether physical or digital native (Catalini and Gans.,2020). More specifically, when it occurs to trade physical goods (technically called ***off-chain assets***) there are some huge difficult challenges that instead are not present when the traded objects are digital (***on-chain assets***). These difficulties are related to the process of **tracking physical goods** and the necessary *synchronization* of events that happen outside the chain (such as the delivery).

On-chain assets are those that only reside on the blockchain. Crypto-currencies, like bitcoin or *ERC-20* standard crypto-tokens, are examples. Both are considered to be part of their respective blockchains' original ecosystems.

From a technical point of view, Blockchain can only record the creation or the transfer of on-chain assets.

Physical goods or other intangible assets that exist in the actual world, such as vehicles, patents or houses, are examples of off-chain assets. Such assets and blockchains do not have a natural link. As a result, when a blockchain has to record or track the transfer or production of off-chain assets, those assets must be associated with the blockchain, which is commonly done by tagging and mapping them into the blockchain (Mik, 2018).

However, blockchain and smart contracts cannot interact directly with off-chain events in the actual world. This constraint is solved by using *oracles*, which are third-party service providers who give information about the outside world. As a result, anytime payment depends on off-chain contractual events, such as the delivery of a physical object, the smart contract must “call” an **oracle** to confirm that the event has actually occurred. Furthermore, oracles acquire information about such occurrences from other data sources rather than creating or verifying it themselves. As a result, the parties engaged in a smart contract must agree on a reliable third party, the oracle, and on its reliable sources of information. The problem is known as "***garbage in, garbage out***" because if the recorded data is wrong, the record in the blockchain or smart contracts will be erroneous as well.

The need to rely on oracles and other data sources, of course, undermines the decentralized nature of public blockchains. Indeed, each oracle can be viewed as a necessary "pocket" of centralization (Mik, 2018). In the end, when it comes to consider blockchain uses beyond cryptocurrencies, the concept of a "trustless" system is inaccurate and disingenuous.

Subramanian (2018) provides an analysis of decentralized marketplaces based on the current literature. Faster transaction speeds, lower costs, and better privacy and security for consumers are all advantages he sees in implementing blockchain-based markets.

He also examines the decentralization potential for a variety of product and service categories, including physical items, which he claims will only achieve *partial* decentralization owing to the complexity of monitoring events and syncing their identities in the blockchain:

E-marketplaces	**Decentralization Possibility**	**Reasons**
Physical products	*Partially decentralized*	Many external events to sync with the chain and many components to decentralize, including B2B support, reputation and the delivery tracking
Digital native products or assets (video, music, tokens, stablecoins)	*Veri likely*	Fully online transaction and delivery
User-generated content marketplace	*Veri likely*	Online content, including blogs, reviews, and online reputation
Prediction markets	*Veri likely*	Blockchain-based validation to enforce contracts

Crowdfunding, sharing marketplaces	*Veri likely*	Simpler validation; functionality supported by blockchain
Currency exchanges, complex financial contracts	*Veri likely*	Easy-to-create complex contracts and low transaction costs

Table 6. Level of possible decentralization according to the nature of items

For each marketplace model corresponds a possible degree of decentralization. When only fully digital goods are traded then a high level of decentralization is possible.

6.3.3. IMPLICATIONS

All of these criticalities lead to one of the *most difficult challenges* for blockchain-enabled networks: **decentralized governance**. In the context of blockchain, governance refers to the establishment of rules and guidelines that govern access rights, transaction legitimacy, conflict resolution, the issuing of new assets, and tokenization. The accepted governance is frequently coded *on-chain*, in the self-governed consensus algorithms for instance. However, governance may takes place *off-chain* in certain blockchain-enabled platforms. Even permissionless blockchains like Ethereum use some off-chain governance procedures for a range of choices including feature proposals. The Ethereum Github homepage and the Ethereum Community Forum are examples of off-chain channels. Stakeholder validation is required for on-chain operations, but it is not always required for off-chain activities. Managing these two types of governance procedures parallelly, in a full decentralized manner, it's a huge problem for blockchain-enabled platforms' growth.

That why, in the interviews conducted by García Sáez (2020), most of the blockchain experts believe that "*developing governance models is particularly difficult and should come before technology decisions, as the latter will apply the agreed-upon regulations and internal procedures*".

6.4. CASE STUDY OPEN BAZAAR: WHY IT DIDN'T TAKEOFF

In order to give an example of decentralized marketplace and to show how these criticalities may affect such model, I will present *Open Bazaar* case study.

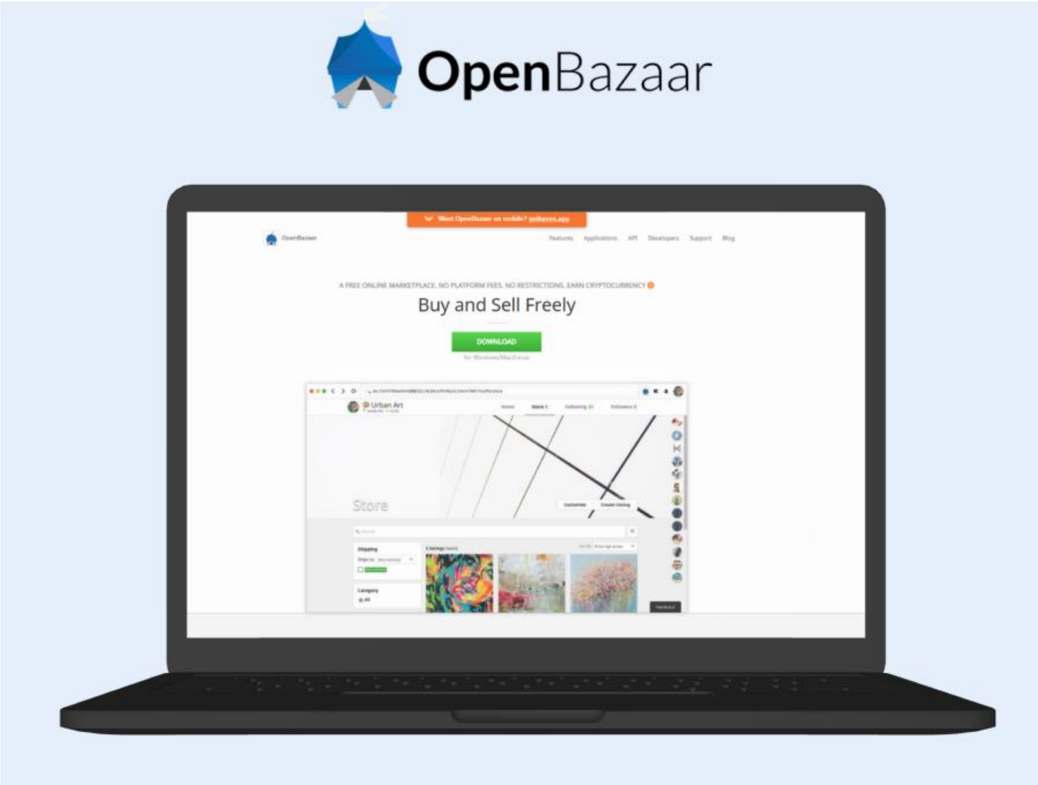

Figure 12. Open Bazaar marketplace

Open Bazaar was an *open-source* project born in 2014 with the aim of creating a fully decentralized marketplace for *peer-to-peer* E-commerce based on blockchain technologies. The project raised several million dollars (about $9.25 million) in seed funding, from important VCs, through a startup called OB1.

The value proposition of the marketplace was to provide no transactions fees and no restrictions to what can be traded and who can trade on the platform and no tracking on purchasing behaviour of users. OpenBazaar is a platform that lets buyers and sellers connect directly to sell their goods without involving a third party to host the data and charge a transaction fee. The creators wanted to build on the idea of creating a truly free trade platform enabling everyone to sell anything to anyone anywhere in the world for free. The main *features* were:

- In comparison to eBay and Amazon, there is **no middleman** who charges fees or restricts offered products and services.
- User can decide the **level of disclosure of their personal data**: they can participate anonymously or only reveal the personal information they choose.
- Everyone in the OpenBazaar network is a node in the **P2P** network.
- All users on the platform can act as: *merchant*, *buyer*, and/or *arbiter*. **Users can choose what role** want to build their reputation for and are not limited to one role.
- The main **currency** presently in use is Bitcoin, no payment provider or banking account is needed.
- Possibility to **directly pay** through cryptocurrency or to use a moderator service to hold the funds in escrow until the item is received.

How it works

First of all, to transact on the OB marketplace, users must download an OB server (i.e. the back-end application allowing the network to function) and an OB client (i.e. the visual front-end application enabling users to communicate and control the server).

Now, imagine Alice wishes to join the OpenBazaar network and purchase an item. First, she downloads the OpenBazaar client from website, where she is presented with a "Get Started" page which allows her to edit her profile. Once Alice creates her account, she can explore the listings on the platform.

When Alice clicks on a *listing* she is interested in, her client attempts to fetch the relevant information from the vendor. So, she is brought to a listing page which contains information about the item such as its price, description, shipping details, preferred cryptocurrency *payment* method, and pictures of the item. When purchasing an item through OpenBazaar, Alice may opt to directly send cryptocurrency to Bob to pay him, or to use a *moderator* service to hold the funds in escrow until the item is received. Moderators are OpenBazaar users who volunteer to mediate disputes between other users and decide the eventual distribution of funds using *multisignature transactions*, and usually do so in exchange for a small fixed-percentage fee.

In the end, Alice sends her payment details and shipping information to Bob through the platform and the sale proceeds as it would on existing services such as eBay.

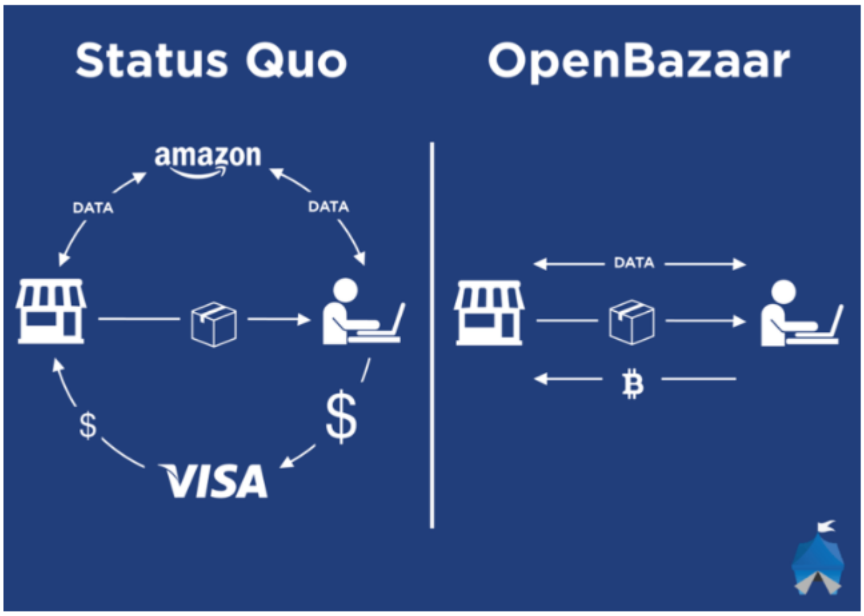

Figure 13. Differences between Open Bazaar and traditional marketplaces

Advantages for users

The users on the OpenBazaar network are incentivized to participate because they have greater freedom than they would on other e-commerce platforms: the policies for are less restrictive, they don't have to give up personal information that could be stolen from or sold by the platform, and they don't have to pay any fees to the platform.

Value creation and value capture

The *value creation*, as mentioned before, is pretty straightforward since OpenBazaar basically provides improvements in the areas of policies, personal information and fees: users can freely trade while having more freedom, in a more secure and transparent environment, and pay less.

Value capture is limited to the buyer and seller, who benefit from the value created. As a project, OpenBazaar didn't appear to capture any monetary value, except in brand equity as a trusted place for peer-to-peer e-commerce.

The end

Unfortunately, OpenBazaar, has not gained much traction to actually start the new era of decentralized electronic commerce, as it promised, and on Jan. 4, 2021, the project's leadership announced that OB1, the company that developed the OpenBazaar open-source software, would have ceased supporting the marketplace's wallets, APIs, search engine and website.

According to the interview release to Yahoo Finance in June 2021, by the ex CEO and co-founder of OB1, Brian Hoffman, the main *reasons* behind the *failure* are:

- The fact that they didn't shift from bitcoin to **Ethereum** blockchain
- The high **volatility** of Bitcoin made the marketplace inconvenient to daily "Amazon-type E-commerce" purchases. The introduction of an internal token as **stablecoin** to make internal purchases, would have created price stability. Moreover, the introduction of an internal currency would have helped the reaching of a *critical mass*. Indeed, early adopters would have been rewarded for their efforts in bootstrapping the network thanks to potential *re-appreciation* (see previous chapters), and liquidity would have increased for buyers and sellers.
- They had **limited revenues** options since they never charged users a fee for using the platform.

- Due to the **strict fully decentralized** framework and the "*intrinsic*" governance of the code, they didn't really engage the community in potential improving decisions, they didn't try to understand real users' need nor satisfying their requests.
- The project required a higher **learning curve** for users compared to centralized alternatives: users were expected to possess a high level of computer literacy. Indeed, the audience was primarily composed by developers and early technology adopters.
- Finally, the majority of internet users are **skeptical** and distrustful of bitcoin for many reasons, including that it is difficult to explain and understand and it has dramatic price volatility. Subsequently, the low consumer **trust** and the perception of **high technical barriers** to entry is enough to send curious technology adopters back to the familiar Amazons and eBays to conduct their e-commerce.

In addition to the above-mentioned reasons that led to the failure of the project, there are also some *considerations* to do that are related to the criticalities illustrated in the previous paragraphs:

In the end, they tried to implement a full decentralized marketplaces by focusing on the concept that there's no "*central organization controlling the platform*". In practice, however, this resulted in a number of inefficiencies.

First of all, the **absence** of a formalized governance process and an official central entity overseeing the system, made it *unclear* who selects which *improvements* make it into the platform's code. For the same reason, it was unclear what would happen if one of the system's components failed.

Secondly, it resulted in an **unstainable BM** due to *absence of revenues stream*.

Thirdly, it resulted in the need to "*indirectly*" reduced the **level of decentralization** by introducing the role of verified moderators, thus giving to OB1's *de facto* decision-making power. This can be considered as an example of an "*informal, opaque governance structure*" (Mik, 2018) that indirectly contradicts the full decentralized character of the marketplace promised.

Finally they didn't leverage benefits coming from blockchain-based platform BM, such as ***token effects***. For instance, the establishment of token economy would have made possible reaching a critical mass easier or at least tried.

6.5. ORIGAMI NETWORK CASE STUDY

Considering all the reasons illustrated and the failure aspects of Open Bazaar case study, I will now take into account marketplaces that propose a kind of "**semi-decentralized**" framework (Chen et al., 2021). This framework allows its users to **clearly** participate in making decision about rules, governance, and future improvements for the overall wealth of the platform while still having some key individuals **explicitly** leading platform governance, at least in the first stages of launching of the marketplace platform.

In particular, I will explore **blockchain-based marketplace** that *leverages* blockchain technology, essentially, to carry out *one or more* of its critical operations to keep the involvement of trusted third parties to a *minimum* and rely on self-enforcing protocols wherever they can.

A case that represents an example of this concept is **Origami Network**. As illustrated in their white paper, Origami Network is an *all-in-one* decentralized *protocol* for building decentralized marketplace, based on Ethereum blockchain, and solves several existing problems related to online marketplace development and maintenance, escrow payments, and reviews. It was born in 2018 backed by some French banks and is still active.

Figure 14. Origami Network marketplace

The *value proposition* is to give to clients (e.g. companies that want to launch their online marketplaces or sharing economy platforms) the ability to build *their* online marketplace easily and get the benefits and power of the decentralization through the Ethereum Blockchain. The result is a faster, easier, cheaper, and more reliable marketplace experiences for both consumer and business owner.

The main problems targeted by Origami Network are:

a) **Fees** on the centralized escrow payment systems are usually high, and cut the margin of the marketplace operators. Origami Network reduces these fees, thanks to the ORI tokens.

b) Customer **reviews** are a huge problem in the online marketplace industry. It's essential to give back the power to the customers and sellers through a more secure and trustworthy review system. Decentralization in Origami makes this possible through an unbiased system in which fake reviews are impossible and moderation is transparent.

c) Shipping is also a big issue in the online marketplace industry. Origami secures the shipping by **tracking** retrieval through Oracles to avoid these issues. For instance, returned or not sent packages trigger an automatic refund to the customer.

d) Payment **disputes**: as on server-centric payment, sometimes there are problems with refunds, or payments. Through the Ethereum blockchain Origami try to solve those issues.

To make a link to what illustrated in the previous chapters, Origami perfectly embodies the **separation of the role** of the *platform provider* that happens once blockchain technology is implemented.

Indeed, Origami both provides its blockchain protocol as ***PaaS*** to its customer to build their online marketplace easily and also plays the role of a service provider: in particular, Origami Network is based on three self-sufficient services:

I. **Origami Marketplace (PaaS):** it provides four modules to easily and fastly create online marketplace.

II. **Origami Payment**: it is a decentralized payment system powered by the Ethereum blockchain and ORI token. This system enhances the buying/selling process with decentralized escrow payments. Using the power of the Ethereum smart contracts technology, escrow payment management is automatized, and no third-party is needed to control the flow of money. The result is lower fees (around 0.8% to 1% per transaction). It can be integrated into new or existing marketplaces and is designed specifically for P2P marketplace transactions where trust between the buyer and seller might be limited.

III. **Origami Review**: it implements a blockchain-powered review system. Every review is authenticated through smart contracts, and solely users who have conducted a prior transaction can post reviews. They do this by signing with their own private key before posting their review. Also, a review can be posted only when the order is delivered.

These complementary services can be used in a modularized framework or together.

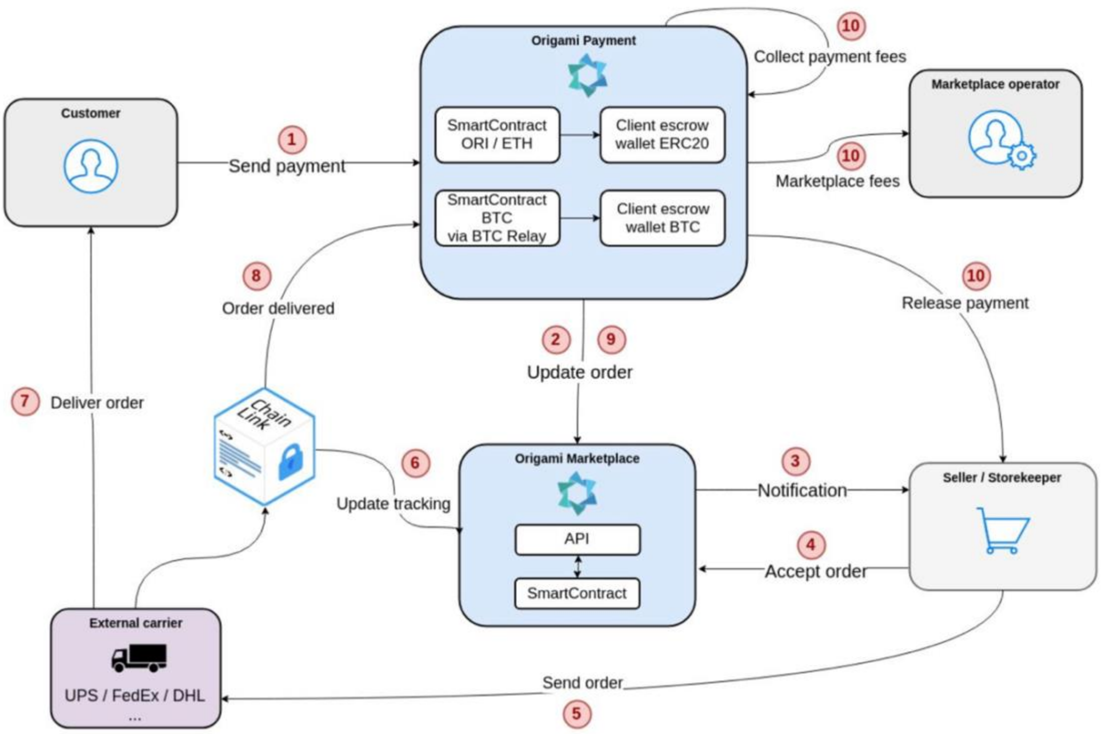

Figure 15. Overall representation of the working flow

Key features

- The presence of an internal currency, the **ORI token** that is ERC20 compatible.

  The **benefits** for token holders are: - By paying with the ORI tokens, the fees will be lower than with any other currencies; - Sellers can also use their ORI tokens to attract more reviews for their shops; - Customer is rewarded with ORI when its review is validated; - Participate in the project decisions: ORI Holders, will have a set of tools to follow and participate in the project decisions by getting voting rights on next features. Users become part of the project; – As Origami Network spreads and customers start to implement their solutions, the ORI Token will become usable on a very large set of marketplaces and sharing economy platforms.

- The presence of **oracles** (automatized) that to get critical external off-chain data necessary for solving smart contracts (e.g. to validate that packages are really delivered to unlock the payments). Chainlink is the oracles used, it is a decentralized platform that allow to get info from carriers about the shipment.

- **Payment method** accepted are: ORI, ETH, BTC, FIAT
- The **revenue stream** is represented by fees paid by customers to build their own marketplaces plus transaction fees (composed of Ethereum network fees + Oigami network fees)

Actors involved

Operators: They could be people from Origami's or clients' team. They manage several aspects of the online marketplace. Even if the reviews and the payments are decentralized, at the beginning of the life of an online marketplace, operators need to recruit sellers that will sell on their marketplace. They need to work on the marketing and advertising of the marketplace. Operators are an important part of the launching of an online marketplace.

Sellers: They are the companies/individuals that will sell on the online marketplace.

Customers: The users that will use and buy (goods or services) on the online marketplaces.

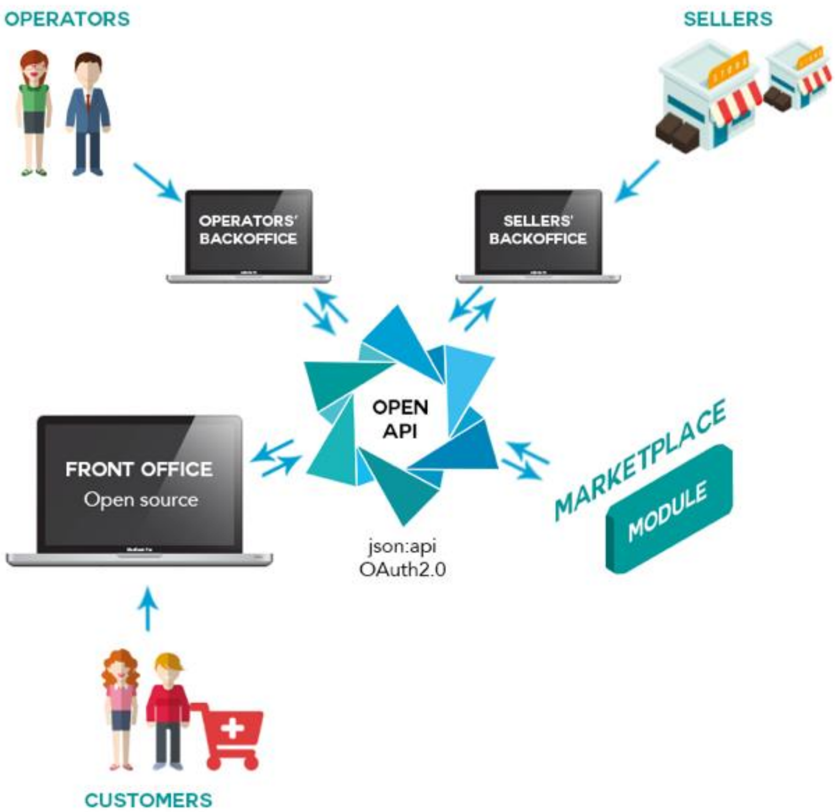

Figure 16. Actors involved in Origami marketplace ecosystem

Advantages of the solution

- Reduced transaction **fees**
- Decentralized authenticated **review** system
- **Moderation** is transparent through decentralized oracles
- **Rewards** system for users
- The paradigm shift, associated with mass adoption of Origami marketplace, would see sellers go from having separate identities and reputations across multiple platforms to sellers having a **single identity** that is owned, controlled, and stored in the blockchain.
- In the same way, ORI tokens could become a **general currency** to transact in many different marketplaces

BLOCKCHAIN-BASED MARKETPLACE	TRADITIONAL MARKETPLACE
Origami Network Origami Marketplace + Origami Payment + Origami Review	Traditional Platforms Amazon or Airbnb
Network Model Decentralized. Supported by users	Owned and regulated by a third party
Direct payment by cryptocurrencies with Origami Payment and offer low fees	Personal information is required and can be hacked and stolen
Payments are instant and don't require any intermediary.	Traditional marketplaces lack transparency
Validation by network prevents security problems.	Payments go through third-party financial services with high fees
Personal information isn't required Smart contract are unbreakable and executed automatically	Charges a percentage of every transaction (example Amazon ~15%) Must comply with terms set by the third party
Origami Reviews will decentralize reviews management and improve the reputation management system of sellers on any marketplaces.	Manipulate reviews, post fake reviews, delete negative reviews, or post negative reviews on their competitors' pages.

Figure 17. Main differences between Origami marketplace and traditional ones

This case study allows to make a constructive comparison with Open Bazaar. Below the main differences:

Firstly, according to blockchain-based platform model, it evidences the separation in two different roles of the platform owner in **blockchain provider** (*Origami marketplace*) and **service provider** (*Origami Payment* and *Review*).

Secondly, it's not just a single decentralized marketplace project but instead Origami provides an "ecosystem of services" for different *companies-specific* marketplaces with the potential for further evolutions (one token currency for multiple marketplaces).

Thirdly, it introduces an *internal token economy* thus triggering *token effects* to rapidly gain critical mass and create incentive for users to contribute to the growth of the platform (*reward system* based on ORI tokens).

Fourthly, it is not focus on proposing a full centralized governance but instead it aims to address some problem typical of traditional platform (transaction fees, fake reviews, potential disputes, power concentration of marketplace owner) by keeping the involvement of trusted third parties to a *minimum*. As a result, it tries to **engage community** of users giving them also the rights to propose improvements. In the same way it transparently introduces actors (internal operators) that help to set up the *operations*, at least at the beginning, necessary to guarantee the *efficiency* of the whole platform (*partial disintermediation*).

As a natural consequence, in contrast to what happened with Open Bazaar, a **sustainable BM** with a sustainable *revenue stream* is created. All this happens, while still leveraging the main benefits of blockchain-based decentralized marketplace such as confidence, security, disintermediation, empowerment of users ecc...

6.6. A THREAT OR AN OPPORTUNITY FOR MARKETPLACE OPERATORS

The risk

As previously stated in earlier chapters, the adoption of blockchain technology in two-sided platforms alters the conventional essential function that a marketplace operator plays. Indeed, there's a *shift* from an intermediation role to a **service enabler** role for the sides. This effectively indicates that the platform is no longer a mediator between parties' interactions, but rather a support for peer-to-peer connections. In other terms, the function of facilitating and enabling economic transactions between two or multiple sides become something granted by the underlying technology represented by blockchain. This can happen because in a decentralized platform, the technology behind the scenes performs and manages all economic and data transactions, whereas the platform makes a step back, allowing users to communicate directly and freely. As a consequence, in contrast to traditional platform models in which users are strictly linked to a single entity, the platform owner that controls all users' data and transactions, this innovative process makes the **risk of disintermediation** real. This also provides an innovative perspective on the role of platform operators in comparison to the more traditional one, which sees a digital platform as a tool specifically created to facilitate transactions between different sides of users that would otherwise be unable to interact (Evans 2003).

However according to a large portion of literature, is *unlikely that electronic markets will be fully disintermediated by blockchain technology anytime soon* (Fuelner et Al 2022; Zamani et al .,2017; Chiu and Shang., 2019). Instead of a complete disintermediation, it is a more likely scenario where the role of existing intermediaries will transform, **changing the nature of intermediation** so that their involvement in market processes will be *reduced*. This latter will happen by progressively redefining how they add value to transactions.

Indeed, disintermediation is not always possible and sometimes not even allowed. In certain domains there is a need for traditional trusted intermediaries to safeguard business processes, particularly in the highly regulated financial sector. Furthermore, local *regulations* might require a trusted intermediary for certain market processes, for example, when there is the need to verify the identity of business relations to prevent criminal activities (this process is known as Know-your-Customer or KYC).

For the same reasons, Zamani and Giaglis (2018) stated that a complete disintermediation is not possible. More specifically they believe that decentralization-based technologies will imply the roles of intermediaries may reduce considerably but these intermediaries will still be useful within a blockchain-enabled environment rather than completely disappear.

Indeed, while it is easy to replace institutional intermediaries for the facilitation of transactions with blockchain technology, it seems more difficult to determine the *product offering, involving new sides, provide legal and regulatory infrastructures.*

In the table below, there's a further illustration of the level of substitution of traditional platform functions that it's possible to reach through blockchain. Specifically, the transaction function is related to the marketplace, the facilitating function reflects the engagement process, and the logistical function refers to the flow of goods, resources, and information.

The basic functions of the intermediary	**Capability of blockchain technology (Is blockchain technology capable of replacing the function?)**
Transactional functions (marketplace)	
• Increase market linkages.	Partially
• Reduce transaction costs.	Yes
• Establish a buyer–seller relationship.	Partially
• Bear risks.	Partially
Facilitating functions (engagement)	
• Provide relevant information.	Partially
• Make agreements.	Yes
• Enable/provide financing.	No
• Provide a post-purchase customer experience.	Partially
Logistical functions (the flow of goods, resources, and information)	
• Physical distribution.	No
• Integration of information and shared resources.	Yes

Table 7. level of substitution of traditional platform functions that it's possible to reach through blockchain

Continuing with the analysis and assuming the perspective of users, a question may come up: *What is the factor that disincentives users to entirely refuse the intermediation service provided by the platform?* The answer is linked with the role of **token effects** and the underlying incentives for **holders**: having one group of users completely committed to the holding and use of tokens is sufficient to greatly lower the risk of a full disintermediation.

Indeed, every token holder is interested in the value of tokens and so in the platform's sustainability and survival (as illustrated in the previous chapter). In this way, the internal **token economy** and the connected token effects, creates a *win-win* scenario in which, not only the platform owner but also every user that hold tokens get benefit from *avoiding a complete disintermediation*.

These considerations open new interesting possibilities for platform providers. From one side, as illustrated before, in a decentralized ecosystem, users can assume much more roles and responsibilities. In this process of responsibilization of the users, the platform provider can take a step back and, at the same time, create a sort of **lock-in effect**. Indeed, *users are kind of "locked" into the internal token economy of the platform* since they invested in the project (by being token holder) hoping for a future *re-appreciation*. **Incentives**, distributed in the form of tokens, represent a technological and economic glue which keeps all the community around the platform more and more close-knit.

The opportunity

Another question that could arise from this discussion is: *Is the disruptive innovation of blockchain a threat or an opportunity?*

Several researchers proposed different possibilities for traditional intermediaries to react to the threat of disintermediation, for instance leveraging blockchain technology to strategically reposition themselves within the market. Indeed, as said by Zamani (2017) "*we consider DLT to create numerous **opportunities** for the development of new application areas and business models*". Researchers believe that intermediaries will **reinvent** themselves and develop new business models in order to keep their relevance, despite the fact that decentralization-based technologies would reduce the value of intermediaries' original role.

They will still be able to offer significant value to customers and maintain market influence by concentrating on **complementary activities** such as:

- understand market trends and customers' needs; - create business opportunities between potential buyers and sellers; - supporting regulatory compliance; - increase market linkages; - provide financing facilities; enhance the post-purchase customer experience; - distribute physical products efficiently and effectively; - ensure market safety and integrity; - certifying info that requires off-chain verification; - monitoring participants; - maintaining trustworthy reputation systems.

In the end, they will become **facilitators** of the interoperability between a network and a community of users. In a nutshell, they are expected to provide a **complementary infrastructure** rather than a competing one (Zamani., 2017).

As a consequence, according to Fuelner et Al (2022); marketplace operators, rather than being subjected to real disintermediation, they probably face a "**Re-Intermediation**" that occurs when an institutional intermediary finds a new position or function in the market. Through reintermediation, the traditional intermediaries try to build upon their expertise, experience, and market positioning, new business opportunities to maintain their existence in the market.

However, since through the implementation of blockchain networks, also new intermediaries might emerge providing new services in the market that did not exist before, another possible outcome of disintermediation could emerge: the "**Cybermediation**" (Zamani et al., 2017).

It occurs where new intermediaries entering the market, offer previously unthinkable services to transacting parties in DLT networks (e.g wallet providers). This may refer to intermediaries acting as DLT service providers, offering Blockchain as a Service (BaaS). For the adopters of such a service, the benefits would be similar to those of cloud computing, where the management and maintenance of the infrastructure are controlled by the provider, thus allowing the customer to focus on its primary business activities while easily implement blockchain in their businesses. An example of companies that act as BaaS service providers is Microsoft. The tech giant offer "Azure Blockchain Workbench", a collection of Azure services, that facilitates developers in quickly deploying blockchain applications allowing deployers to focus on building business logic and driving business processes with smart contracts.

Therefore, to answer the question posed before, **disintermediation represents both a threat and an opportunity for marketplace operators**. Indeed, on the one hand blockchain accelerates disintermediation thus creating a risk. However, the technology itself does not unconditionally replace the entire functions of the intermediary because blockchain technology itself is not an autonomous entity that has the capacity of understanding customers' needs and sellers' offers. It does not have cognitive, analytical, and strategic mindsets needed to perform and maintain business operations. For this reason, a compete disintermediate is not likely to happen. Instead, a re-intermediation is a more probable scenario. *This creates opportunities to marketplace operators* to *strategically reposition themselves* in the platform by providing **additional** or completely new **services** that could *secure their role by still increasing the value for users.*

6.7. EMPOWERMENT OF USERS

As illustrated in the previous chapter, the new role of platform owners as service-enabler allows the presence of new empowered relationships between users and the platform itself. Moreover, token effects make users become considerably more engaged and responsible in the activities of platform. This provides platform owner with new significant opportunities. Users can take on more roles and responsibilities in a decentralized environment, such as commerce *collaborator*, *validator*, controlling rules, and so on. Such positions, which are usually unrelated to the side of belonging, foster deeper ties between sides. In this process of users' empowerment, the platform provider may take a step backward in terms of managing transactions and interactions, handing over control to these new empowered users.

6.8. OPPORTUNITIES TO IMPLEMENTATION

To conclude, below there's a list that identify some key characteristics and settings where blockchain technology appears to be a powerful alternative to today's centralized marketplace solution in terms of efficiency and user experience (Catalini et al., 2020):

- **Distance between sides**: Decentralized platforms, by leveraging tokens, are able to meet users' interests. This may be quite effective, especially when a company relies on the ability to create a community that is built on similar aims and specific requirements. In conventional centralized businesses, the two primary sides of a two-sided market represented by sellers and buyers, are often extremely distant. As a result, the equilibrium shifts more towards one of the two side in terms of advantages or drawbacks for the parties. The token economy enabled by blockchain has the potential to mitigate this situation.
- **Middlemen engaged**: One of the first factual implication that blockchain technology shows is cutting out the middlemen in any peer-to-peer transaction, as noted previously. As a result, blockchain technology can be a useful option in businesses where the number of intermediaries and the associated transaction costs are particularly high.
- **Reputation of users**: Blockchain is a significant alternative to centralized systems in a situation where users' reputation and identification is a sensitive issue. Blockchain's technological qualities result in a high level of transparency. On the one hand, all users' actions are accessible to other network members, despite the fact that individuals can remain anonymous. The public-key cryptography mechanism, on the other hand, ensures that users' identities are protected. Furthermore, because people may be rewarded for having a good reputation score, the token economy motivate people to maintain a high level of product quality.

- **Necessity of trust**: Transaction or contacts requiring reliance between two sides can be facilitated by blockchain. Indeed, this technology solves the problem by establishing a trustless ecosystem. Decentralized platforms have the ability to deliver trust and security by default, eliminating the need to add security solutions to its infrastructure.
- **Existence of economic transaction between sides**: Blockchain implementation in businesses where sides participate in economic transaction is much more meaningful since the main benefits of blockchain are reduction in transaction costs, product authenticity, traceability and certified users' identity.
- **System of rewards**: The token economy gives rise to inventive and engaging incentive schemes, all of which help to boost user engagement and involvement in the marketplace.
- **Level of sensibility to privacy**: The strength of this technology, in terms of privacy, lies in the fact that it allows users to choose the data they want to make public. Cryptography, on the other hand, can check users' identities and ensure secure transactions even in presence of anonymous individuals.
- **Data reliability**: When a marketplace struggles to ensure reliance on data, or when this component is particularly sensitive for users, blockchain technology appears to be particularly helpful. Indeed, all data saved on the blockchain may be trusted thanks to blockchain properties.
- **Complexity of payments**: Many variables may have a role in raising the criticality and complexity of payments. First, because there are so many actors engaged in a financial transaction in a centralized reality, verification times tend to be exceedingly long. Furthermore, there are several instances of cheating while trading money over the internet. Traditional circuits frequently impose commissions, which are just as significant. Blockchain technology has the potential to alleviate all of these problems, at least in part.

- **Risk of fraud**: The blockchain has a remarkable ability to decrease fraudulent activity. Decentralized platforms can not only avoid fraud but also respond quickly when it occurs. Indeed, the sequential properties of blockchain reduces the time to track back a product.

In the end, the integration of **blockchain characteristics** and **platform ecosystem**, is what actually constitutes a real innovation in comparison to previous traditional models. These two elements, indeed, combine together to create new, strong, and intriguing **dynamics** in the platform.

7 CONCLUSION

The aim of this report is to give an overall illustration of the transformation brought by blockchain technology, once applied in the context of platform, particularly in two-sided markets, and how this technology can re-shape the main dynamics and characteristics of these successful business models.

Regarding this first goal, the main evidences and key implications that have been presented during the analysis are the following:

First, blockchain technology offers many different *opportunities and incentives for new business models to emerge*. Depending on the implementation, these incentives might be linked to the large cost savings resulting from disintermediation, improved data traceability and verification, or the creation of trust and engaging dynamics among system participants.

Second, blockchain technology can support platforms' growth and *trigger new interesting mechanisms upon two-sided markets*. Indeed, blockchain does not completely disrupt the traditional model of two-sided platforms but may actually **enhance** it.

Most of the dynamics that characterizes the two-sided platform model are changed or even extended as in the case of same-side and cross-side network effects and the relationships among sides. More specifically:

I. Even if blockchain and other DLTs fits the definition of a two-sided platform, there are substantial differences: traditional two-sided platforms rely on a central intermediary, the owner and manager of the platform. Instead, blockchain-enabled platforms are ecosystems on which other platforms work (PaaS). In practice, they provide an infrastructure or protocol which is used for many different services on top of it.

II. The **separation of the two roles of platform providers** as well as the creation of new roles for users, have implications on boosting the existing network externalities and creating new ones: the token-based externalities.

III. This new model of platform may **mitigate** some of the traditional challenges of two-sided platforms, such as the chicken and egg paradox and the need to build up trust between the two sides.

IV. A **well-designed token economy** is the fundamental means by which efficient mechanisms, token effects, can be used to incentivize early adopters in order to overcome the chicken-and-eggs problem, while, at the same time, maintaining platform utilities and growth through active contributions of users. Tokens, become a precious tool in the hand of platform provider and serves to keep together the interests and aims of parties since the very early stages.

V. The **role of users and community become essential** in blockchain-based platforms compared to traditional platforms, not only in creating value through their activities, but also in capturing value and raising the level of sharing across the entire system thus leading to the so-called "*democratization of innovation*" phenomena.

VI. Platform-based companies, enabled by blockchain, create new forms of resource configurations that generate new kinds of value creation and capture opportunities based on sharing incentives. This is also supported by the **decrease** in the **cost of verification** and **networking** brought by the implementation of the blockchain technology.

Moreover, this Report also tries to explain the nuanced and complicated concept of decentralized marketplaces, to understand what are the main differences and potential benefits when compared to traditional centralized models. Also, the report tries to investigate whether this decentralized framework represents a threat or an opportunity for marketplace operators and what is the factor that keeps the whole network together despite the possibility, to users, for a potential complete disintermediation from platform owners. The main takeaways are:

I. **Decentralization challenges the paradigms of today's traditional markets**, by eliminating the need for a middleman that has complete control over transactions, activities and user data and information.

II. There are still several **criticalities** that limit a mainstream diffusion of decentralized marketplaces models such as technological obstacles, synchronization of off-chain goods or events, social reluctance in blockchain, high volatility of cryptocurrencies, legal requirements compliance and lack of regulations.

III. A **full disintermediation is unlikely to happen** because is not always feasible and depends on the context of application. Instead, it's more likely that the role of existing intermediaries will transform, changing the nature of intermediation so that their involvement will be reduced (*Re-intermediation*). As a consequence, marketplace operators should consider the advent of blockchain not as a risk but as a **golden opportunity** to reinvent themselves and create BMs to maintain the utility of their position in the marketplace. They are expected to provide **complementary activities** rather than a competitive infrastructure.

IV. The presence of **token holders** is the only way to **avoid users to completely disintermediate** the service provided by the platform owner. Indeed, every token holder is interested in the value of tokens and in the platform's sustainability and survival (token effects). As a result, every user that hold tokens get benefit from avoiding a complete disintermediation.

V. Open Bazaar case study shows that the main challenge for decentralized marketplaces is represented by the achievement of a full decentralized governance while keeping the whole BM sustainable without contradicting the concept of decentralization.

Indeed, focusing only on "the absence of an official central entity" may lead to several inefficiencies such as the rise of opaque form of interventions by platform "owner" thus indirectly reducing the level of decentralization. As a consequence, it's essential for marketplace-enabled by blockchain, in order to achieve superior platform performance, to rather implement a "**partial decentralized"** framework, where users can expressly participate in making decisions and future improvement with the presence, at least in the first stages of launching, of explicit key figures leading the governance of the platform (e.g Origami Network case). Through semi-decentralization, blockchain-enabled marketplaces may be better able to improve the balance of power between platform owners and platform participants and to ensure effective value creation and fair value distribution.

In the end, the most powerful innovations brought by blockchain technology in the context of platforms are the **token economy** and the related **token effects** that affect and generates new interesting dynamics on platforms' ecosystem; and the fact that the reduced cost of networking allows for the creation of ecosystems where the benefits coming from **enhanced network effects** do not come at the cost of increased market power and data access for platform operators.

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