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**NFT and the Work of Art in the Era of Digital
Reproduction:
Insiders' Perspective on Blockchain's Effects
in the Digital Art Domain**

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ABSTRACT

Digital objects cannot afford the plenitude guaranteed by analogic assets, the reason being their ambivalent ontology that lacks the stability afforded by traditional media. Therefore, the intrinsic characteristics and the nature of these assets make it impossible to collect them and difficult to archive. However, in the last months, a market branch implying a new technology that seems to solve the issue, surged: NFT.

NFT, or Non-Fungible Tokens, are the combination of digital assets and an underlying digital passport, recorded on a blockchain and immutable by definition.

This master thesis' main purpose is to understand, from the opinions and perspective of insiders, if blockchain technology can compensate for the unstable and unbound nature of digital artifacts, justifying the craze around NFT.

First data was collected in 2021 from different insiders of the NFT community, that can be categorized into two main groups: artists and collectors. Interviewees work in and gain from this market segment, making them the most suitable profiles to outline the structure of these assets. With a comparative research approach, answers and opinions are then analyzed side to side with the theoretical framework of the project, which mainly includes notions about digital artifacts and blockchain technology.

Answers were collected with online meetings or through written interviews. Given the homogeneous group of experts, results have been consistent and comparable throughout the project and show that blockchain technology can, indeed, overcome problems of authenticity, scarcity and provenance.

In the conclusive part of the thesis, properties of Non-Fungible Tokens are outlined, drawing from theory models of digital objects and blockchain technology.

Keywords: digital artifacts, blockchain technology, Non-Fungible Tokens, scarcity, authenticity.

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1. INTRODUCTION

This first segment aims to summarize the theoretical framework underlying the project, stating the relevant research questions for the discussion, and briefly describing the structure of the document.

1.1 ABOUT NON-FUNGIBLE TOKENS

1.1.1 Background

In the last months, a new digital asset has monopolized discussions about art and collectibles, creating a market segment that now allows transactions for billions of dollars weekly.

Technically, NFT, or Non-Fungible Tokens, are indivisible digital assets record on distributed public ledgers that can guarantee uniqueness of another digital asset. Non-fungible because they cannot be interchanged, by the very nature of the blockchain. Tokens because they allow access to other information.

Basically, they are packets of data recorded on a blockchain; more specifically they are certificates recorded on a blockchain. However, digital assets have been studied and theorized by different scholars in the last 20 years, and blockchain's models have been discussed since the '80s and are meticulously analyzed since the introduction of Bitcoin, in 2008.

Why should NFT, then, be academically relevant?

1.1.2 Academic relevance

NFT have become synonym with a combination of assets that seems to solve problems related to digital artefacts. Even if, technically, they are only certificates, the market defines NFT as the unique combination of a digital asset, such as digital artwork, and a digital passport that is recorded on a blockchain and is, therefore, immutable. The reason being that NFT usually represent digital assets. This peculiar combination implies a series of properties that digital assets do not possess.

Throughout this thesis, the word NFT is used with its common definition (the combination of a digital asset and its digital passport), rather than its technical definition.

The main problems with digital art is that usually digital assets cannot be authenticated, they are abundant and they are infinitely reproducible without consequences. These properties make digital artifacts impossible to collect. On the other hand, data recorded on a blockchain

is immutable and traceable in space and time, two characteristics that are in contrast with the nature of digital artifacts.

In theory, blockchain technology can provide a new system of authentication. In fact, by recording transactions on a public ledger, a history of ownership is guaranteed. Moreover, thanks to the immutability of the blocks, ownership cannot be falsified. This model solves two main issues: authenticity and traceability of a digital asset, allowing the proliferation of cryptocollectibles and cryptoart.

The intent of the thesis is to understand if theory about blockchain technology and digital assets can be combined to describe the intrinsic properties of NFT. The purpose of the thesis is to understand if these properties can create disruptive innovation in the art segment.

1.2 RESEARCH QUESTIONS

Due to their recent implementation and popularity, academic literature lacks a model which describes Non-Fungible Tokens. The purpose of this project is to understand NFT properties and trace a structure that can be academically relevant and a reliable contribution when describing these digital assets. The main research question underlies in the possible contradiction that involves properties of blockchain and digital assets:

- *Can blockchain technology overcome the limits and challenges of digital artifacts?*

The question is inserted in the context of collecting art. To draw a reliable model, NFT are compared, throughout the document, with traditional art. We know from Kallinikos, Aaltonen, Marton (2013), in fact, that digital objects lack the plentitude and stability afforded by traditional media. In this comparison, more implicit research questions will emerge throughout the document and will be inserted in the interview. Blockchain's nature, and its ability to create unique immutable certificates, will have the same implication throughout the thesis, especially regarding the issue around reproducibility of digital assets and the desire to collect them.

All these implied questions help to pave the structure for NFT and identify their main properties, some of which they share with digital artifacts, some of which they share with blockchain technology. The properties outlined in the document, in the end, will answer the question:

➤ *Can NFT create disruptive innovation in the art market?*

1.3 STRUCTURE

The document is composed of 4 main sections, in addition to the introduction segment and the conclusions part, being the theoretical framework, the research design, the results segment and the discussion part.

In the thesis' introduction, a brief background of the project and its purpose are provided, in addition to the underlying research questions.

In the theoretical framework of the thesis, academic literature is reviewed to provide a context around the project. In particular, there are two main sections: one dedicated to digital objects and the ease of reproduction, with this last part being based on Benjamin's essay "The Work of Art in the Age of Mechanical Reproduction" from 1935, which also inspired the title of the project. In the second section, blockchain's models and theory are presented and NFT are described with the help of existing literature.

In the research design segment, all the procedures that have been necessary to write this document, are listed. The main research method is outlined and validated by the results. The interview model used with experts is reported in this section of the document.

In the results section, empirical findings are presented. All data has been collected from interviews and, when necessary, it has been integrated with secondary data. To facilitate the reading and understanding of the document, answers were quoted when relevant, or summarized otherwise.

In the discussion section, results from the previous chapter are analyzed and compared with the theoretical framework of the project. Personal contribution is added, mainly about the properties of NFT and to explain the peak in popularity of this technology.

In the conclusive part of the project, the final conclusions are presented to answer the research questions and to summarize the project. Suggestion for future research is added, due to the recency of the topic.

1.4 RESEARCH DESIGN

The research is based on a comparative structure between the different empirical findings reported, to understand where a generalization of answers can be outlined to have academic relevancy. The model of research used can be defined as a qualitative investigation.

The recency of the phenomenon and the lack of previous theoretical structure both imply that qualitative data has to be collected from insiders.

Moreover, the research questions aim to understand perspectives that can be observed from inside only.

In light of the NFT market's model, which identifies the two actors involved in an exchange in artists (sellers) and collectors (buyers), the interviewees' profiles were easily determined. A third perspective from marketplaces' point of view would have been interesting, despite not being crucial, but the low numbers of relevant platforms and the difficulty in contacting them made it impossible to collect.

The results are correlated to theoretical models about digital objects and blockchain technology. For this reason, the research started with the outlining of the theoretical framework and the needed academic contributions.

Once the theoretical framework had been identified, the next step was understanding the origin of problems about archiving digital artifacts.

The issues in archiving digital artifacts can be primarily correlated to the non-materiality of digital objects and the absence of a state of scarcity. These problems, combined with the two main research questions, outlined the interview draft and what was crucial to understand from insiders.

All the contributions collected with the interviews have been analyzed, integrated with secondary data, compared to theoretical models and completed with critical thinking and personal contributions. The conclusive part of the project shows that empirical findings have been crucial to answer the main research questions.

THEORETICAL FRAMEWORK

This section is devoted to outlining the theoretical framework of the project. The academic literature is reviewed to provide a context to the research and ease the understanding of the topics treated.

Due to the peculiar nature of NFT, which are composed of a digital asset and an underlying digital passport, the chapter is divided into two sections: the first about digital artifacts and the ease of reproduction, the second dedicated to blockchain technology and its application in the NFT model.

2. THE AMBIVALENCE OF DIGITAL ARTIFACTS

This first chapter is devoted to the academic theories about digital objects. In the first module, digital artifacts are described, their main intrinsic properties are listed and their ambivalent ontology of quasi-objects is discussed. The second length of this chapter is dedicated to Benjamin's project "The Work of Art in the Age of Mechanical Reproduction", an essay from 1935 that describes the state of art following the popularity of art's reproduction, a context that can be compared to the circumstances in which digital art evolved.

2.1 DIGITAL ARTIFACTS

To better understand the world of digital art interlinked with blockchain technology, we need to define a few key concepts and fully explore their facets, when it is possible.

2.1.1 Background and definition

In a landscape of digital and digitalized artworks, we first need to define digital objects (or artifacts) and their main characteristics. Thanks to Kallinikos, Aaltonen, Marton (2013), there is a clear path to be followed and certain contributions that must be considered.

The first definition we give is the one about digital artifacts.

We simply define a digital object, or artifact, as any type of item produced and stored in a digital version; while we define a digitalized object, or artifact, as any type of a material item's version that has been transformed into a digital item.

Digital artifacts are featured on digital ecosystems and they derive their utilities from their relationship with them (this is indicated by the growing prospect of combining software's components across different platforms).

We define digital ecosystems as the digital counterparts of biological ecosystems, exploiting the self-organizing properties of biological ecosystems, which are considered to be robust, self-organizing and scalable architectures that can automatically solve complex, dynamic problems (Briscoe, De Wilde; 2007).

Thanks to the academic work of the last few years, even if digital innovation – as the carrying out of new combinations of digital and physical components to produce novel products (Schumpeter; 1934) – cannot be followed in real-time, we will try to analyze perks and challenges of digital artifacts.

2.1.2 Properties of digital artifacts

The first thing we have to clear is that digital artifacts are intentionally incomplete and perpetually in the making (Garud, Jain, Tuerstcher; 2009). This is because the digital world and its extensions are continuously changing, adapting and generating new processes.

This peculiarity can be both an opportunity in the ever-changing digital landscape, and a problem when control is lost over the artifact.

This is the most relevant fact stated in Kallinikos, Aaltonen and Marton's work (2013) and why they underlined that digital objects have, in fact, an ambivalent ontology: they are, indeed, objects, but lacks the plentitude and stability afforded by what we can call traditional objects.

Different scholars have expressed similar feelings: for example, Ekbia (2009) states that is better to identify digital artifacts as quasi-objects and that they have a “dubious ontology”, while Faulkner and Runde (2009), building on John Searle' theory of social reality (1995), refer to this property as a “dual nature”.

Other contributions have been made during the years and they all underline that digital objects are artifacts embedded in complex ecosystems constantly changing.

For instance, another important contribution by Faulkner and Runde's work (2009, 2011) has been delineating the identity of digital objects by studying and then describing their immaterial status and their reproducibility.

Some of the just exposed ideas are found in other scholars, while other features are drawn in the next years: for example, Yoo's contribution (2010) about reprogrammability and self-referentiality.

Even though they are conceived as objects, digital artifacts differ from what we can call analog objects along several dimensions (because of their ambivalent nature). Their intrinsic properties are:

- Editability. To begin with, digital objects are editable. They can be updated and quite possibly, at least in principle, modified a number of infinite times.

Editability is a broad concept that can be simply achieved by rearranging elements of which a digital object is formed, by deleting some of the aforementioned elements, by adding new elements, by modifying some of the functions of individual elements; this can include constant updating of said object or some of its data fields.

- Interactivity. Digital artifacts are interactive, meaning that human interaction can activate certain types of functions embedded in the artifact. Interactivity does not result in immediate modification of the object, as editability do; its key characteristic is allowing information exploration.

Editability and interactivity are two properties that fall into the umbrella of malleability, one of the main features of any artifact (Orlikowski; 2000. Urlich; 1995).

- Openness and reprogrammability. Digital objects are open and reprogrammable, meaning that they are accessible and modifiable by a program other than the one governing their behavior (Kallinikos and Mariategui; 2011. Manovich; 2001. Zittrain; 2008).

Openness and reprogrammability differ from editability because the latter is tied to a logic of reorganizing, adding, deleting content linked to the digital object, while openness and reprogrammability are linked with the logical structure of the object and to the concept of interoperability.

- Distributable. Digital objects can be distributed. For instance, digital objects are transient assemblies of functions, information items, or components spread over information infrastructures and the Internet, a condition that sets them apart from physical objects (Kallinikos, Aaltonen, Marton; 2013).

- Self-referentiality. Digital objects are self-referent, meaning that they require digital technology to be operated, created, produced, stored, modified, deleted, etc. Therefore, the diffusion of digital technology creates positive network externalities and lowers entry barriers for similar technologies, accelerating the diffusion rates and lowering the learning costs (Yoo, Henfridsson, Lyytinen; 2010).

- Addressability and traceability. Digital artifacts are addressable and traceable. That is, each digital object can be uniquely identified and traced in a computing

architecture and helps with enrolling artifacts in global infrastructures, such as the Internet. However, a clarification is needed: traceability does not mean that the history of a digital object can be traced (traceability in time), but rather that in a digital network, the position of a digital object can be identified (traceability in space).

- Senseability. Digital artifacts can be senseable, aware of the context and, along with interactivity and intra-interactivity, these properties allow digital artifacts to communicate with each other (Yoo, 2010).
- Communicability. Digital artifacts are communicable and can interact with actors in digital ecosystems.
- Memory capacity. digital artifacts are memorizable, meaning that most digital objects have some type of memory capacity.
- Associability. Digital artifacts are associable, meaning that some of the information they carry is associated with actors, other artifacts, places, events.
This type of behavior allows the existence of folksonomy, a classification system where content is classified into categories with some type of metadata tag.
- Desirability. Digital artifacts can be desirable, a condition interlinked with humanistic values (such as ethics, aesthetics, responsibility).
- Instability. Digital artifacts are unbounded and unstable (Ekbria, 2009) by their very nature, and their dual ontology shows in resisting reification due to their abstract nature.
- Automation. Finally, digital objects are automatic, meaning that they allow for the automation of many operations involved in media creation, manipulation and access, removing humans from certain steps of the creative process (Manovich, 2001).

Most of these properties are achieved by digital objects because they are numerical representations, meaning that they are composed of digital code (Manovich; 2001).

However, their digital nature implies that digital artifacts are in constant flux and thus difficult to preserve over time (Coyle; 2008), offering a vivid illustration of the challenges raised by the editability, openness and distributedness, ease of reproduction of digital objects; all properties that make them impossible to collect and difficult to archive.

2.1.3 On the dematerialization of digital artifacts

Digital artifacts are deeply linked with physical objects and are not accessible nor usable without them: to access documents we need some sort of device, to listen to music we need headphones, to view a movie we need a TV, to read an e-book we need an e-book reader.

Indeed, while the term ‘dematerialization’ is often used to refer to the shift from physical, tangible items toward intangible digital consumption objects (e.g. Bardhi, Eckhart; 2017. Belk; 2013. Magaudda,;2011), it is broadly acknowledged that digital items are not entirely ‘immaterial.’

Magaudda (2011), for instance, proposes that that digital music consumption “[does] not mean less materiality and [does] not imply a less relevant social role for material objects within consumption processes.”

He concludes that “material ‘stuffs’ still occupy a relevant position, and materiality seems to ‘bite back,’ playing an even more essential role in consumer practices” (Mardon, Belk; 2018).

This deep link between hardware and software products can be viewed both as an issue and a way in which digital objects can gain unique properties.

Moreover, the popularization of digital artifacts helped the technological progress: think about the miniaturization of hardware or the increasingly powerful processors, the expanding memories or the download speed of your home connection.

These discussions of digital materiality often focus upon the materiality of digital technologies and storage media. What of the materiality of the code itself? At their core, the digital items that we consume and possess consist of digital code - a series of ones and zeroes – and Blanchette (2011) argues that there is much to be learnt by approaching this code as a material object or substance (Mardon, Belk; 2018).

In fact, scholars agree that digital code itself has distinct qualities: it is non-rivalrous and infinitely replicable (Ekbia; 2009. Kallinikos, Mariátegui; 2011. Kallinikos, Aaltonen, Marton; 2013).

Due to the digital code non-rivalrous nature, digital objects are associated with abundance rather than rarity.

2.1.4 Implications of digital artifacts’ properties

Digital artifacts are also linked to two other important concepts: granularity and modularity. The first one refers to the minute size and resilience of the elementary units that compose a digital artifact, while the latter is associated with the organization of items and operations that make up a system in distinct and relatively self-sufficient blocks that allow

independence. While granularity refers to what the blocks are made of, modularity concerns the relationship between the blocks.

In sum, modularity and granularity generate some of the most important characteristics that are distinctive of digital objects.

Some of the aforementioned properties can be linked to other dependent characteristics of digital objects: for example, modularity allows a digital object to be recombinable.

Moreover, throughout the years, different scholars have highlighted similar properties, as the ones just listed, but categorizing them under different names; for example: what Faulkner and Runde call “infinite expansibility”, Kallinikos simply calls “editability” and Manovich calls “variability”.

Finally, the nature of digital artifacts, their intrinsic nature and the properties of the code that composes them, make them abundant, easily replicable and infinite.

2.1.5 Layered Modular Architecture

The characteristics of digital artifacts pave the way for the layered modular architecture of digital technology.

The layered architecture, best described by the Internet, consist of four layers: devices, networks, services, contents; with digital artifacts being contained in the latter layer.

The four layers represent different design hierarchies (Clark; 1985) and the individual design decisions for components in each layer can be made with bare consideration of other layers. Therefore, designers can pursue combinatorial innovation by gluing components from different layers through standard protocols.

The modular part of the model is found in the standardized interfaces between components, increasing flexibility and decreasing complexity (Yoo, Henfridsson, Lyytinen; 2010).

The layered modular architecture is a hybrid between the two models described, where the boundaries of a product are fluid and allows generativity within the use of the product, while maintaining standardized interfaces to reduce the complexity of the system.

2.2 BENJAMIN AND THE EASE OF REPRODUCTION

2.2.1 Background

In 1935, German philosopher and critic Walter Benjamin wrote an essay about the ease of reproducing an artwork in a socio-economic context in which mechanical reproduction contrasted the ritual value of art. “The Work of Art in the Age of Mechanical Reproduction” (Benjamin; 1935) is almost 90 years old, but can still be related to the context in which digital art is finding space to proliferate. For instance, Benjamin talks about authenticity and the value of the art in a mass-society context.

The essay opens with a quotation to Paul Valéry in which the French poet states that “the amazing growth of our techniques, the adaptability and precision they have attained, the ideas and habits they are creating, make it a certainty that profound changes are impending in the ancient craft of the Beautiful” and continues saying that “We must expect great innovations to transform the entire technique of the arts, thereby affecting artistic invention itself and perhaps even bringing about an amazing change in our very notion of art” (Paul Valéry; 1928).

2.2.2 Artworks’ aura and the concept of authenticity

After the preface, Benjamin starts its discussion by stating that a work of art has always been reproduced: by pupils to master their craft, by artists to diffuse their work, by third parties for personal gain. He also states that techniques to reproduce an artwork has always existed, but that the more advanced they developed, the more meaningless the art became. With film, in fact, a work of art is reproduced with hardly more than a hand movement.

In the second section of the essay, Benjamin argues that “even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be”. He also states that the concept of an original supposes the concept of authenticity.

Through this section, the German critic states that an original, when confronted with its copies, always maintains a level of authority that is unobtainable in reproducing a piece. He states that the reason is twofold.

First, process reproduction is more independent of the original than manual reproduction, meaning that the copy of an item can evidence details that could be unattainable in the

creation process. Second, technical reproduction can put copies in situations that would be out of reach for the original, meaning that the context changes the perception of the object.

In the same section, the concept of “aura” is introduced. The aura of an artwork depends on two main characteristics: the authenticity of the item, the locale (in time and space) of the item. Therefore, even the most accurate reproduction of a work of art cannot be compared to the original, because it lacks the original’s presence in time and space.

2.2.3 Masses’ influence and the shift in value

In the next section, Benjamin resumes the concept of aura from the previous paragraph, but with a different view. He states that, to comprehend the influence of the mass on the value of an artwork, it can be useful to refer to aura of natural objects and define their aura as “the unique phenomenon of a distance, however close it may be”. To facilitate the reading, he adds this example:

“If, while resting on a summer afternoon, you follow with your eyes a mountain range on the horizon or a branch which casts its shadow over you, you experience the aura of those mountains, of that branch”.

Benjamin states that this image makes it easier to comprehend the influence of the mass over an artwork. In fact, contemporary masses have a desire to “bring things closer, spatially and humanly”, a desire that is just as strong as their inclination to overcome uniqueness of every reality by accepting its reproduction.

In the following sections, Benjamin argues on the value of the artwork in relation to the environment surrounding it. He states that there are two opposite poles that work for an artwork: the cult value and the exhibition value. When statues are venerated, they are accessible only by visiting a temple; however, when the same statue loses the veneration perspective, because of progress in social values, it can be moved into different museums, increasing its exhibition value. Mechanical reproduction works along the latter perspective, and separated art from its basis in cult.

This new predominant layer changes the function of art. Once, an artwork was functional before being aesthetic, and only in retrospective items were labeled as artworks. Today, the exhibition value of the art influences its main purpose and provide art with a new meaning

and entirely new functions, which “later may be recognized as incidental”. This is the main influence of the mass that Benjamin recognizes.

To some degree, the essay critiques the new social context in which art is reproduced, but the critic is mainly directed to new forms of media that gather and can be observed by numerous groups of people, in particular to films. He attributes to films and new media the change in the masses’ perspective, that no longer search for enjoyment and contemplation in art, but rather for distraction. In Benjamin’s essay, the same logic cannot be applied to paintings, that were never meant to be enjoyed by more than few people. However, Benjamin recognizes positive consequences in the ease of reproduction: first and foremost, the property of the new art of being accessible to a wider audience.

3. THE STABILITY OF DISTRIBUTED LEDGERS

The third chapter incorporates the second section of the theoretical framework. In a similar fashion as the previous chapter, this portion is divided into two collateral segments. The first part is dedicated to blockchain technology, its intrinsic properties, its structure and how it functions. The second part is dedicated to the existing literature about NFT, their history and their main applications.

3.1 BLOCKCHAIN

3.1.1. Background

One of the main problems of digital artifacts is that they are easily reproducible.

In a context like digital art, this is a big issue concerning the work of artists that seek scarcity as a way to maintain or increase the value of their craft and collectors that do not want to support an illegal market of counterfeit products.

The best, fastest and most reliable way to prove the authenticity of any item is by using documentation issued by the artist themselves or a reliable third party; but even documents and certificates can be falsified and reproduced.

In a context of materiality, the authenticity of a document is often proved by marks that cannot be easily replicated, like some watermarks or other subtle symbols. In a world of non-materiality, this is extremely more complicated. Therefore, digital items are certified through the use of Blockchain technology, which we can simplify and discompose as an incorruptible online data storage.

Blockchain technology is so reliable and faster than traditional documentation that is nowadays utilized, to certify the authenticity of selected items, in a wide array of industries that deal with valuable material artifacts such as the luxury industry and the diamond industry.

Different scholars have proposed a Blockchain-like model throughout the years. We can go back to 1982 to find the first theorization by David Chaum.

The first-ever functioning protocol has been brought to the public in 2008 by a group of anonymous authors that goes under the name of Satoshi Nakamoto. The following year, Nakamoto (2009) implemented its original design as a core component of the cryptocurrency Bitcoin, where it serves as the public ledger for all the transactions happening in the network.

Bitcoin is now extremely known (it is, in fact, the most popular and unitary valuable cryptocurrency) and had a rise in popularity in the last few years: in fact, all the transactions made in the first six years, from 2008 to 2014, occupy roughly 15 GB, while the transactions occurred in the next six years, from 2014 to early 2020, occupy roughly 230 GB, for a total of nearly 250 GB. At the time of writing this paper, the Blockchain stores 360 GB of data, of which roughly one third was produced in the last two years.

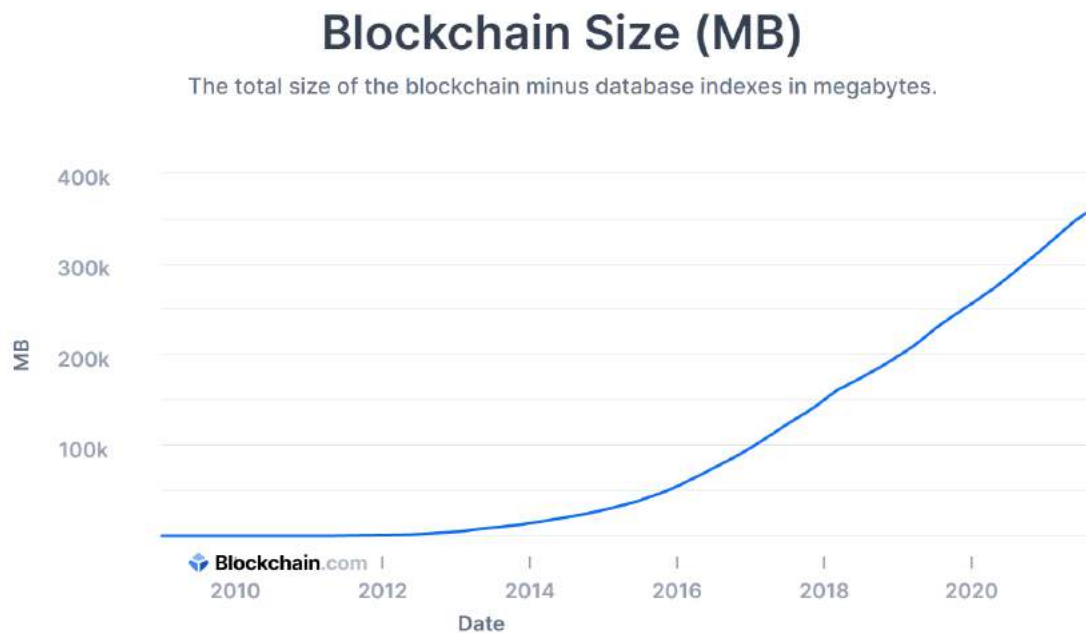


Figure 1. Blockchain size in MB. (blockchain.com; 2021).

3.1.2 Blockchain's mechanism

The blockchain is a sequence of blocks, which holds a complete list of transaction records like a conventional public ledger (Lee Kuo Chuen; 2015); the “blocks” that compose the chain are data packages where a single block contains multiple transactions.

Each block is connected to the previous block (with a sequence identified as “has of block $i-1$ ” for every i block) and the chain is extended by each additional block on top of the *genesis* block (the first block of the chain, that connects to no previous block).

Blockchain relies on its unique model that allows transactions to be made without involving a third party. A single block is composed by

- Block version: indicates which set of block validation rules to follow.
- Parent block hash: a 256-bit hash value that points to the previous block.
- Merkle tree root hash: the hash value of all the transactions in the block.
- Timestamp: current timestamp as seconds since 1970-01-01T00:00 UTC.

- nBits: current hashing target in a compact format.
- Nonce: a 4-byte field, which usually starts with 0 and increases for every hash calculation, used to verify the hash.

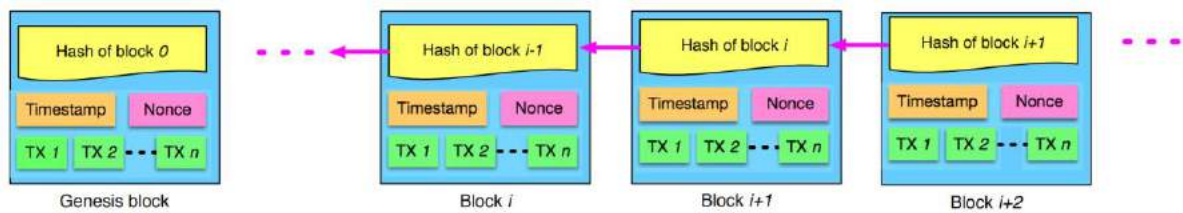


Figure 2. Blockchain's blocks mechanism. (Zheng, Xie, Dai; 2018).

Hash values are unique and this concept ensures the integrity of the whole structure and prevents fraud. In fact, a change in a single block in the chain would change the unique value of its hashes.

A block can be added to the chain if the majority of the nodes in a network agree by a consensus mechanism.

According to Swanson (2015), this consensus mechanism “is the process in which a majority (or in some cases all) of network validators come to an agreement on the state of a ledger. It is a set of rules and procedures that allows maintaining a coherent set of facts between multiple participating nodes”. Therefore, new transactions are added to a temporary block before being transferred to the ledger, when verified.

Once a block is registered by the ledger, the data and information that it contains, cannot be changed.

3.1.3 Types of blockchain

This is the principle of how the technology work, but there are some variations among the different versions of Blockchain. For example, in Bitcoin's Blockchain, blocks are created by *miners* that are rewarded with cryptocurrency when they validate a block.

Different types of blockchain differ from each other for different properties: although a blockchain is by definition distributed (meaning that its information is spread across different segments), the ledger can be either centralized (owned by a company that can access all the data) or decentralized.

Blockchain can also be permissionless (everyone can access the ledger) or permissioned (it is mandatory to be invited by the administrators of the network to access the ledger, that decide who can be a node for the network).

Even though the categorization of different blockchains can be complicated, we can identify at least 4 different distinct types of blockchains:

- **Public blockchain:** a network that is both decentralized and permissionless, everyone can access the network.
- **Private blockchain:** a centralized chain that is usually permissioned. Consortium blockchain also falls under the umbrella of private blockchains and are owned by a group of companies.
- **Hybrid blockchain:** a chain that blends features of the two previous types. There is no amount of permissionless or permissioned features that are required to identify a specific network as a hybrid blockchain.
- **Sidechain:** a network which runs parallel to a primary blockchain. Entries from the primary blockchain can be inserted from the primary network, allowing the sidechain to operate independently (keeping a separate record of transactions).

3.1.4 Properties of blockchains

Despite the existence of different types of blockchains, these networks share some fundamental properties. In the following, we describe the main properties of blockchains:

- **Publicly verifiability:** they allow anyone to verify the correctness of the system's state. Even private ledgers, that are restricted to a set of participants, are observable from the outside, at least up to a certain length of the chain.
- **Transparency:** since they are observable and verifiable, the networks have to be transparent. Auditability, as the ability of tracing any transaction thanks to its timestamp, fall under the same umbrella.
- **Privacy:** this property seems in contrast with transparency, but every system has a certain degree of privacy, e.g., a distributed ledger provides the full state of every transaction, while guaranteeing anonymity to the party that seal the transaction. Some scholars categorize privacy under the name of anonymity, as each user is only linked to an address and could use multiple addresses to preserve its identity.
- **Integrity:** of information. The data is protected from any unauthorized modification. Some scholars categorize this property under the name of persistency, as each block have to be confirmed and validated from other nodes, before being recorded. The system does not allow tampering, as falsification is easily detected; other authors call it immutability. The immutability of the chain enables trust between the users and within the system.

3.1.5 Consensus Mechanism and Proof of Work

The model used to determine whether a block is trustworthy among untrustworthy nodes and reach consensus is called consensus process and is a variation of the Byzantine Generals Problem (Lamport, Shostak, Pease; 1982. Zheng, Xie, Dai; 2018), a game that falls under the umbrella of Game Theory.

In the Byzantine Generals (BG) problem, a group of generals who commands the Byzantine army, circles a certain city that will be attacked. The attack can be successful if all the generals agree to send their portion of the army to attack the city. If some generals do not agree to attack, the attack will be unsuccessful.

It is an untrustworthy environment because there can be traitors among the generals.

The environment is similar to models of public blockchains, where there is no central authority (decentralized environment) and every peer cannot trust each other.

It is necessary, then, to have some protocols to prevent inconsistency across the chain and among the blocks. There are several approaches to reach consensus, but the most common one (used by the most popular blockchain designs) is called Proof of Work (PoW).

First introduced by Nakamoto (2008) in its Bitcoin's blockchain proposed model (and still used in networks like Ethereum and Bitcoin), PoW requires a complicated computational process in the authentication (Zheng, Xie, Dai; 2018).

In PoW, each node of the network is calculating the value of the constantly changing block header (the portion of the block that contains metadata about the block itself). The consensus requires that the value must be smaller or equal to a certain amount.

In a decentralized network, all the nodes are required to calculate this value and, once the correct value is obtained by one node, all the other nodes have to confirm the correctness of the calculation. Once the value is verified, all the transactions made to obtain the value are authenticated and a new block in the chain is added.

Since every block contains information from the previous block, consequentially every block contains all the information contained in the network, thus making more difficult to validate the next block.

For instance, Nakamoto in 2009, in a mail sent to the Cryptography Mailing List, talked about the difficulty to validate every additional block:

“I made the proof-of-work difficulty ridiculously easy to start with, so for a little while in the beginning a typical PC will be able to generate coins in just a few hours. It’ll get a lot harder when competition makes the automatic adjustment drive up the difficulty”.

The nodes are commonly referred to as miners and the PoW as mining.

Since the calculations are time-consuming and energy-consuming, Nakamoto (2008) proposed an incentive mechanism where miners receive an amount of cryptocurrency every time they mine a new block.

It sometimes happens that multiple nodes can generate the correct hash value in the same moment, creating multiple branches from the same chains. However, it is uncommon to simultaneously calculate the value to the next block too, therefore identifying the longer branch as the authentic chain.

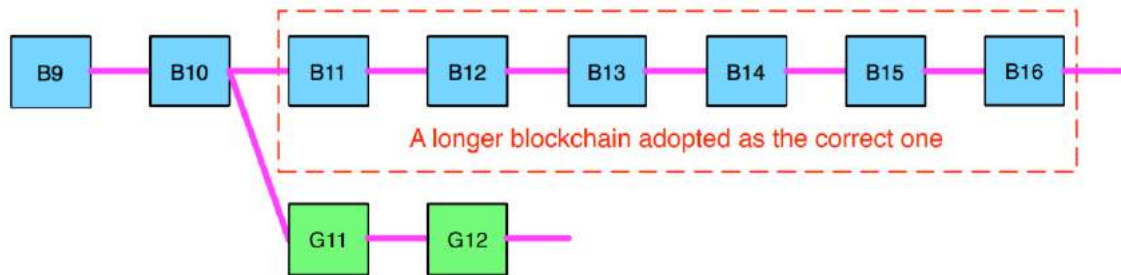


Figure 3. How the authentic chain is determined from multiple branches. (Zheng, Xie, Dai; 2018).

3.2 Non-Fungible Tokens

Combining the unique properties of digital and digitalized items and the authentication method secured by blockchain technology results in NFTs or non-fungible tokens

3.2.1 Background

A non-fungible token is a unique and indivisible blockchain-based virtual asset.

Therefore, NFTs are data stored packets that are recorded on a public ledger, linked to a certain real-world item (that can be physical or digital), and prove authenticity and ownership of the said item.

The first use of NFT can be tracked in 2015, with the Etheria project (that have been mostly remained unsold until the 2021 NFT frenzy), but the majority of scholars agree to identify

2017 as the turning point for NFT with the creation of CryptoKitties, a virtual game where users can purchase, collect, breed and sell virtual cats, and CryptoPunks, a series of digital characters.

Tomaino (2018) traced more than 100 similar blockchain applications the next year, and some of them raised important capital, but today the craze has grown much larger.

To put it in numbers, in the month of January the absolute number of searches on Google for the word “NFT” was less than 30k in the United States, while in the following month the word “NFT” was searched on Google 450k, as Grimes (a Canadian musical artist) sold a reported \$6 million of NFT.

In March, the frenzy was at its peak. Beeple (an American digital visual artist) sold his “*Everyday: The First 5000 Days*” for \$69 million with the help of auction house Christie’s, and the word “NFT” was searched nearly 3 million times in the US (wordtracker.com, trends.google.com).



Figure 4. Searches per month for the word “NFT” in absolute value. (wordtracker.com; 2021).

It was the perfect fire for a match that has been ignited ever since: Sotheby’s had to keep Christie’s pace and organized with Canadian artist Mad Dog Jones a fully curated sale, Opensea (the leading NFT marketplace across all chains) reported last month a billion-dollar week in trading volume, setting a record \$208 million trading volume day in the last week of August. At the time of writing, the daily volume traded at Opensea is larger than what the platforms recorded in the entirety of 2020.

More and more musical artists approached the NFT world in the last few months, with Canadian rapper Tory Lanez selling one million NFT copies of his latest album in less than a minute.

3.2.2 Properties of Non-Fungible Tokens

The craze is justified by how NFTs are built: with similar protocol as of cryptocurrencies and thus often called *cryptocollectibles*; which first mean that in the digital collectibles' world we no longer distinguish NFTs from the items they are attached to, using NFT as a whole indicating the digital passport and the item they are linked to, and second that they have value as collectibles.

This passage is crucial to understand NFT and their value in the digital art world.

Digital artifacts are not suitable items to be collected: they are infinitely and easily replicable, abundant, ubiquitous, hence they do not fulfill the main property that brings value to a collection: scarcity. However, the registration, on public immutable ledgers, of ownership and every transaction made involving a digital item, make possible the existence of only one original item, traced and verified using blockchain.

This is where outside observers raise an eyebrow: blockchain cannot prevent the duplication of one item nor can assure that the uploader of an item is the original creator of said item; Trautman (2021) discuss that we can own next to nothing online.

In fact, the image you see below this paragraph is identical to the one that has been sold for \$69 million by Beeple and Christie's.

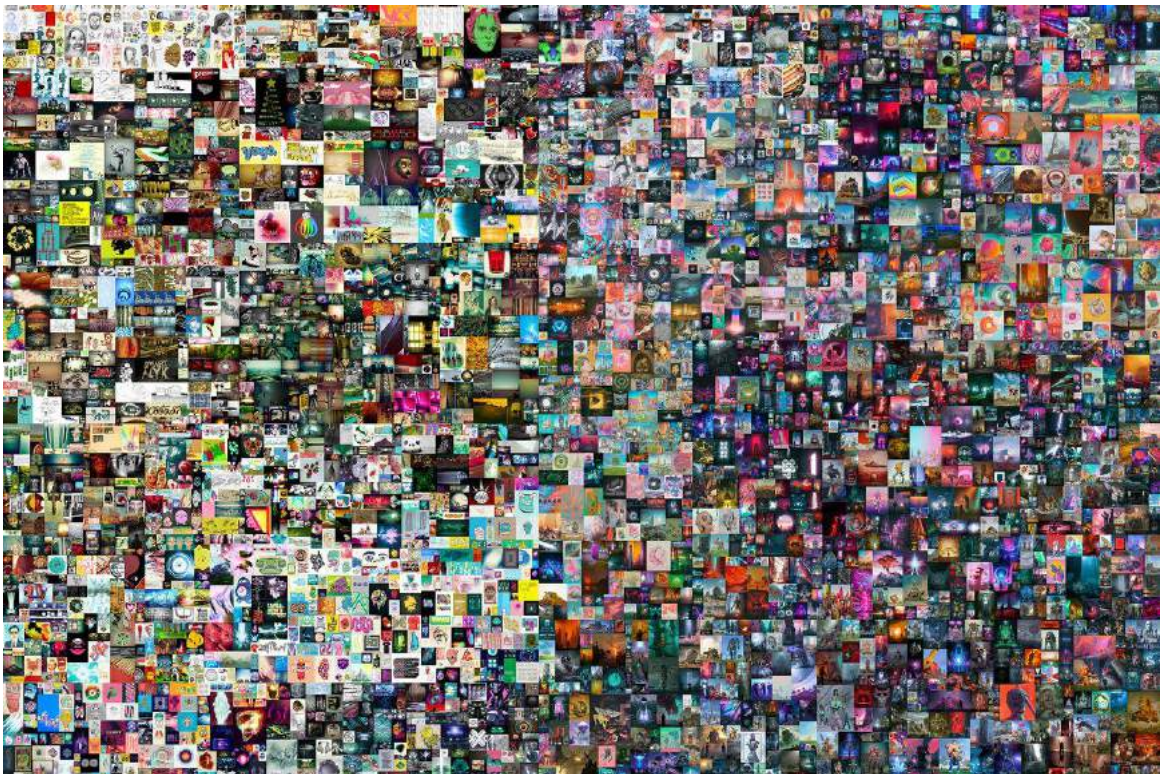


Figure 5. Everyday: the first 5000 days. (Beeple; 2021).

Still, the main reasons to explain the growth in popularity of NFT are that the market perceives NFTs as rare and valuable, and the value is determined by how much a buyer is willing to pay, and that in a context of printed stimulus economy due to the Covid-19 Pandemic, there are large sums of capital that have nowhere to go and are deployed as a surplus in the NFT community (Chohan, 2021). This take outline that NFT are mostly popularized by their monetary value rather than their artistic one.

3.2.3 Existing academic literature

As of today, the main academic contributions to the NFT world concerns its legal framework.

To summarize, the actual legal regime states that digital assets are governed by licenses and these licenses assert that buyers do not, in fact, own the asset. With this legal framework come different problems linked to licenses, e.g., every time an NFT item is sold, the creator should get a fee; the ability to earn based on the art's appreciation value is limited (that some marketplaces even cap) (Trautman; 2021).

Moreover, as mentioned before, the collection of NFT is not merely linked to the artistic value of an item, but often to the value that the item can have if used as a currency Therefore, NFT should have different regulations.

Protocols and standards have been implemented since 2017, most notably the ERC-721, but are not as regulated as they should be and it is impossible to draw a clear line due to the ambiguous nature of these assets.

It is clear that NFT, as the combination of digital property and a non-fungible token, are a category of assets that do not fall under any umbrella that we currently know, due to their ambiguous nature; they derive some characteristics from digital objects' literature and some properties from the blockchain model.

Their legal framework is similar to that of licensed products, but not identical.

Although the contribution of cited scholars is very important as the backbone structure of this document, there is a lack of empirical studies that draw conclusions from experience and experienced insiders.

Rather than trying to draw a model, from existing theories, that could fit this very specific product, it is of extreme interest to understand from artists, collectors and managers of communities what are their thoughts on NFT nature and potential, if *scarcity still matters* in

a world where valuable assets are easily reproducible, what are the *differences between a physical tangible work of art and their digital creations*, to better understand in which way NFT are still art and in which way they are digitalized valuable assets.

4. METHODOLOGY

The intent of this segment is to gather in one chapter all the information about the methodological approach adopted to conduct this study. In the next pages, the research strategy and design are discussed. These also include clarification about how data is collected, analyzed and processed, as well as why these interviewees have been selected. Finally, this section contains the research questions.

4.1 RESEARCH DESIGN AND MODEL

4.1.1 Research Strategy

The project's purpose is not to verify existing theory models, but to understand from the inside what made NFT so popular in the last months and if their popularity is just a spike in an otherwise flat graphic or if the technology can evolve to the point where we no longer talk about digital art in reference to traditional art.

Hence, the discussion is based on an approach that is defined as qualitative and interpretative and the model used is categorized as a qualitative investigation.

The approach is defined as qualitative because the main data for the project is verbal answers collected throughout the last months with interviews, interpretative because the answers are analyzed and processed taking into consideration the existing theoretical models. The main intent was to understand *how* the NFT market operates and the resulting implications.

Within a qualitative investigation model, the interview approach facilitates the exploration of a phenomenon from different data sources, ensuring a variety of perspectives for multiple facets of the phenomenon to be revealed and understood. We are applying this approach in a context where there is no control over the behavior of actors, the problem is of recent interest and the issue has to be contextualized over a period of time.

The best way to approach a qualitative investigation is with a constructivist paradigm. Constructivists claim that truth is relative and that it is dependent on one's perspective. This paradigm "recognizes the importance of the subjective human creation of meaning but doesn't reject outright some notion of objectivity. Pluralism, not relativism, is stressed with focus on the circular dynamic tension of subject and object" (Miller, Crabtree; 1999). With this method of inquiry, interviewees have been able to tell their stories, and, through these stories, the participants are able to describe their views of context. This set of actions helps the research to understand participants' actions and decisions.

Moreover, from collected data, and their comparison with the existing academic literature, it is possible to trace a theoretical model that draws from existing systems.

The research design can be described as exploratory, because the purpose is to understand how the NFT market work and in which direction is headed, with contributions from two categories that act in the same environment, but with different contexts.

The goal of the project is to replicate findings across the answers and obtain similar contributions from different profiles.

4.1.2 Research Method

The interpretative-qualitative investigation model can be pursued with different data sources. For this project, the most suitable form of investigation is interviews. The recency of the segment analyzed and the lack of previous theoretical structure both imply that qualitative data has to be collected from insiders.

Moreover, the research questions aim to understand perspectives that can be observed from inside only. In particular, if blockchain technology can create an environment similar to the context of traditional media. For this reason, interviewed experts are profiles that work with and earn from the NFT community.

Only one interview could be done by online meeting and it has been the only interview conducted in Italian. The profile interviewed is of a renowned Italian artist.

The interview lasted for about 30 minutes and the answers have been transcribed to be inserted in the next chapter.

All the other answers have been collected with written documents and have been conducted with English-speaking profiles. When helpful for the research, the answers will be quoted in the next chapter.

Written interviews collectively add to about 7400 words collected.

4.2 RESEARCH QUESTIONS

To better understand the structure of the interview, the interview methods and the choice of interviewees, research questions previously disclosed are reported.

The main research question contemplates the theoretical framework of the thesis in its entirety and is the foundation for the discussion segment and for the theorization discussed in the following chapters. It includes blockchain technology and digital artifacts, and the main purpose is trying to understand if the first can counter the latter's properties in a context of ease of reproduction.

Can blockchain technology overcome the limits and challenges of digital artifacts?

The answer to this question is built upon the answers to the related, implied, subordinate research questions and it will be the main focus in the discussion section.

Two questions are related to the comparison between traditional art and digital art. The intent is understanding whether the NFT segment can emulate the behavior of the art market or if NFT created a completely new outlet. For instance, with the interview the main objective is trying to understand if *cryptoart can be compared to traditional art* and related to this question, another objective is trying to understand *what are the main perceived differences, advantages and disadvantages of the NFT market*.

An NFT market implies a condition on non-materiality, therefore it was crucial to understand from experts' perspectives if *non-materiality affects the value of an artwork*.

Moreover, scarcity is the main property that identifies an item as collectible. Therefore, the main underlying objective of the first research question is to understand if *blockchain technology can create a reliable state of scarcity*.

The theoretical framework for this implication is based on the properties of digital artifacts and Benjamin's essay.

It is clear that the identified profiles, and in particular, profiles of NFT collectors, are the most suitable to answer questions about the perceived scarcity in the cryptoart market.

Finally, all the evidence collected can be discussed to answer the second main research question:

Can NFT create disruptive innovation in the art market?

For context, we reckon 4 different types of innovation that can be summarized in a 2x2 matrix where on one axis is the type of market (new market, existing market) where the innovation is implemented and on one axis is the type of technology that is used within the innovation (new technology, existing technology). The types of innovation are:

- Incremental innovation: the market niche is already existing, the invention uses a technology that is already existing.
- Disruptive innovation: the market segment exists, the invention applies some kind of new technology. This is the label that we put on NFT and digital creations, where blockchain technology is applied to the art market.
- Architectural Innovation: the market segment is new, the technology used is already existing.
- Radical Innovation: both the technology and the market are new.

4.3 ANALYSIS UNITS

An NFT transaction is performed by two active profiles and one implicit intermediate. In particular, artists (first actor) sell their work to collectors (second profile) by registering an NFT version of their artworks on an NFT marketplace (intermediate).

It is obvious, then, that to collect opinions from inside, the profiles to interview must be either digital artists, NFT collectors or managers of NFT marketplaces. Because of the insightful nature of the questions, opinions from enthusiasts that do not directly deal with NFT would have not been sufficient.

Due to the low number of relevant marketplaces and the difficulty in contacting them, the profiles interviewed include collectors and artists, but not managers of platforms. However, the homogeneous data indicates that these interviews can be academically relevant even without the contribution related to marketplaces. Moreover, the profiles interviewed partially covered the perspective of marketplaces.

The 11 interviewees, that we can define as experts, are categorized as artists (4 total), collectors (3 total), one profile that has identified as both an artist and a collector, two profiles that have identified as community managers and collectors, one profile that has identified as

a consultant for the NFT market and a collector. Some of these profiles are of well-known personalities within the NFT community; however, for privacy reasons, I will guarantee them full anonymity and identify them only by their role.

For a more in-depth look at the interviewees, readers can refer to the following table where all the profiles are complemented with a brief description.

PROFILE	LABEL	DESCRIPTION	METHOD	LENGTH
Artist	A1	Worldwide famous Italian artist. Produces both digital and analog art.	Online meeting, Skype.	31 minutes
Artist	A2	Mature artist. Has been in the industry for many years. Produces both analog and digital.	Written interview, e-mail.	1246 words
Artist	A3	Young abstract artist. Produces both analog and digital art.	Written interview, e-mail	472 words
Artist	A4	College student and artist. Pays off student debt with NFT. Produces both analog and digital.	Written interview, e-mail	684 words
Artist and collector	AC	Swiss artist and collector. Does not rely on art as its main income.	Written interview, e-mail	587 words
Collector (flipper)	C1	Digital collector. Owns art and collectibles. Entered the segment with speculative intentions.	Written interview, e-mail	882 words
Collector	C2	Digital art collector. Never understood the art segment before NFT.	Written interview, e-mail	632 words
Collector	C3	Digital art collector. The community is inspiring them to pursue art creation.	Written interview, e-mail	591 words
Collector and moderator	CM	Digital collector with mainly speculative intents. Manages a community about collectibles.	Written interview, e-mail	1392 words
Collector and administrator	CA	Digital collector. Manages one of the biggest Discord communities about NFT.	Written interview, e-mail	486 words
Collector and consultant	CC	Collector and investment consultant. Entered the segment to become an expert.	Written interview, e-mail	441 words

Table 1. Interviewees' profiles. (Own data; 2021).

4.4 RELIABILITY AND VALIDITY

4.4.1 Reliability

Reliability is the property of a study to produce similar results when performed with comparable operations. Hence, an investigation with the same purpose and similar analysis units should conclude in a similar fashion to this research.

Reliability can be compromised by personal inclinations and the quality or quantity of data collected. Ensured the most neutral position in the context of this project, profiles showed comparable results across the questions, hence inducing to believe that the quality of data can be reputed appropriate.

4.4.2 Validity

The only validity that can be determined in an exploratory study is external validity. Internal validity, in fact, is tied to the nature of explanatory projects.

External validity is the property of applying conclusions of a study to other projects with different settings and surroundings.

This thesis' purpose is tied to the context of digital art, but the results discussed in the analysis segment, can be applied to other contexts involving digital artifacts.

For instance, the same conclusions can be drawn in every context in which blockchain technology is applied to solve issues related to archiving and collecting digital objects. In fact, the environment selected is used as the foundation for a general description of NFT.

4.5 INTERVIEW'S STRUCTURE

4.5.1 Interview's method

The interviews, that are composed of 9 open questions, have been conducted in two different forms: scheduling an online meeting, when possible, or sending the questions to who has been identified as an expert.

It has been decided to use open questions to let the interlocutor feel free to answer in the most discursive and complete way; surveys with options would have not been sufficient to extrapolate reliable answers and could have limited experts in their opinions.

On the other hand, semi-structured interviews help to build the context's border, without tracing an exact path and this is the primary objective of the document: understanding insiders' opinions within the researched topic.

The purpose is to understand how operations are conducted in the NFT world and where it is possible to find similarities and differences with what we can define as the traditional art world.

The goal was to involve and collect different opinions from different members of the NFT community and 11 total answers were collected from different profiles. The experts have been first contacted by e-mail, site forms and social networks (mainly Reddit and Discord, where the NFT community is more deeply rooted).

In the interview's introduction, it is specified that I am researching about NFT and the impact of blockchain technology on the art community; it is also stated that the objective of the thesis is to understand if NFT can be categorized as a disruptive innovation, creating a split with the more traditional art market in producing, selling, collecting, managing, trading, enjoying art products.

All the interviews shared the same basic questions, but some questions have been personalized to better fit the profile of the interviewee. To provide a better understanding of the interview and its purpose, I report the full 9 questions, analyze their utility for the research and provide context when needed.

For the full interview's text, readers can refer to appendix A.

4.5.2 Interview questions

The first two questions identify the expert's role in the NFT community and their history with arts. The questions were identical for all the interviewees.

- 1) What was your first approach to art? What is your current process of interaction with art?*
- 2) Why have you decided to enter the NFT's world?*

These questions may not seem very useful for the purpose of the document, but they are crucial to better understand what draws people into the NFT segment.

I then followed up with questions that relate to the theoretical framework of the document and the literary history of the topic.

Question number 3 is a comparison between digital and analog art. The question is personalized upon the interviewee's role because the purpose of the question is to understand the personal experience of the person. The underlined part is the variable segment in the question (this condition applies to all the underlined segments in the following questions).

3) *What are the major differences, that you experienced, between creating, producing/selling/managing communities about/enjoying etc. digital artworks (both digital and digitalized products) that involve the use of blockchain technology, compared to analog art?*

Question number 4 is similar in concept to the previous, but the purpose of this question is to collect insights from insiders about NFT as a whole process and not specifically about what the interviewee is experienced in.

4) *Which are the major features that differentiate digital art from analog art?*

Both of these questions answer the previously hinted sub-research question:

Can cryptoart be compared to traditional art?

What are the main perceived differences, advantages and disadvantages of the NFT market?

The following two questions concern problems of authenticity, uniqueness, scarcity.

Question number 5 is based on Walter Benjamin's essay "*The Work of Art in the Age of Mechanical Reproduction*" (1935).

In his work, Benjamin states that the new knowledge and technology that allow works of art to be reproduced, distort the very concept of art. In fact, for Benjamin (1935) the main characteristic that distinguishes a work of art from its copies is the "*aura*".

The main critic arose by Benjamin is that art should be contemplated from distance, while the masses bring it closer by reproducing the objects. There is no more contemplation, but rather distraction.

Although the premise of Benjamin's work is that mechanical reproduction shifts art's values in a negative fashion, in the essay he also analyzes the positives of reproduction.

In fact, he states that new technologies can open new paths for art and its meaning, while also stating that mechanical reproduction allows art to be more accessible for more people.

Even though Benjamin published his essay more than 80 years ago, his contribution becomes crucial when applied in a context that can be viewed as similar: today digitalization of art has taken to extremes the ease of reproduction and the availability of the artwork, that is now ubiquitous.

5) Benjamin states that artworks were not originally created for the mass, and only after the age of mechanical reproduction they became "for the mass". Do you think that being able to access artworks more easily can change the value of the artwork? And in which way?

The purpose of question number 6 is to understand if knowledge of owning the original digital artwork can be compared with knowledge of owning an original tangible piece of art.

6) Scarcity is still an objective for artists / collectors / developers / creators etc.? And if it is, is there a method to ensure or create scarcity? Can blockchain technology create a level of exclusivity that can contrast the ease of reproducing digital artworks? How does non-materiality affect the artwork in this process?

These questions' answers are fundamental to one of the implied research sub-questions:

Can blockchain technology create a reliable state of scarcity?

From my personal experience, I found NFT to be extremely connected to forums, blogs, online groups and communities, often owned by platforms and marketplaces.

Question number 7's purpose is to understand whether the ecosystem created around NFT can have an influence on creating art, changing its value, setting trends. The question was slightly personalized based upon the role of the expert in the NFT community.

7) Has an ecosystem (as an interlinked network between different subjects) been created around digital art? If it has, how do platforms, forums, communities, affect the process of

creating / producing / selling etc. art? Did you observe differences between this type of environment related to digital art and the ones connected to analogic art?

One common misconception while discussing digital objects is considering them too abstract. They are not. Digital objects are, for now, deeply linked with physical objects: to read an e-book, an e-book reader is required; to listen to music on streaming platforms, headphones are required.

Indeed, while the term “dematerialization” is often used to refer to the shift from physical, tangible items toward intangible digital consumption objects, it is broadly acknowledged by multiple scholars that digital items are not entirely “immaterial”.

The objective of question 8 is to understand what opportunities NFT can open in this direction.

8) Considering that digital art needs a device to be enjoyed, where is the difference between enjoying digital and analogic art? Is digital art an evolution of enjoying art or is it a new opportunity for the art world where digital art can take a different direction compared to the more "traditional" art? In which way?

Evidence collected with question 8 is fundamental to answer the third and last sub-research question:

Does non-materiality affect the value of an artwork?

It is reminded to the reader that the three underlying sub-research questions pave the way to ultimately build a theoretical structure that answers the two main research questions:

- *Can blockchain technology overcome the limits and challenges of digital artifacts?*
- *Can NFT create disruptive innovation in the art market?*

Question 9 is deliberately the less contextualized and structured question. Closing the interview, the intent was to let the interviewee express their opinion on the direction that NFT can take.

9) *What is the potential of digital art and the interaction between art and blockchain technology?*

4.6 DATA ANALYSIS

Even though some questions were personalized to better fit the interviewee's profile, they all share the same basic structure and can be compared to evaluate, from the inside, the NFT ecosystem. The sample of the projected can be considered limited, but it is nonetheless sufficient to gain perspective on the categories of artists and collectors, also considering that the topic was of no interest for the general public less than a year ago.

Data obtained from the interviewees (that we define as first data) is integrated with data from different sources and with the general knowledge about the topic (secondary data) and then compared to the previous chapter's literature review.

In detail, the main strategy adopted is the logic of comparison of configurations that compares an empirical configuration with a theoretical one (Trochim; 1989). The objectives of the next chapter are, in fact, to understand if the existing literature is compelling to the actors involved in the process and to understand where academic work is needed or where scholars have already provided a sufficient model for the topic.

5. FINDINGS

This chapter is devoted to reporting the main contributions from the different interviews. When suitable and useful for the research, full answers in their entirety will be reported; otherwise, summaries and quotes from the interviews will be reported.

The answers are categorized upon the interviewee's role in the NFT community, easing the identifying of experts and the opinion of different groups. For every question, then, the reader will find a section dedicated to artists and a section dedicated to collectors.

5.1 EMPIRICAL RESULTS AND IMPLICATIONS

Even if some profiles have identified with more than one role, the sections still remain two for an easier reading.

In fact, the decision of dividing the results from interviews in only two sections has been taken to facilitate the understanding, of NFT and their market, from the two main perspectives: creating and selling, buying and collecting.

We reckon three main actors in an NFT transaction: the artist (or seller), the collector (or buyer) and the marketplace. Although a marketplace point of view is missing and would have been interesting, some of the answers reported cover in part the platforms' perspective.

In the next chapter, answers and opinions will be compared with the theoretical framework of the project.

5.1.1 About the experts and their reasons to enter the NFT market

The first two questions, as stated in the previous chapter, are meant to identify the expert's history with arts and NFT.

1) What was your first approach to art? What is your current process of interaction with art?

In relation to the first question, that asked what their first approach to art was, all the artists stated that they became to interact with art before NFT was even around.

To this question, artist A2 responded that their first approach was “*the joy of making art with complete freedom*”, stating that they were “*unaware of the working of the art world and did not have any gallery representation*” pushing them to do their own exhibitions.

Two other artists gave a similar answer, indicating that art has always been their channel to explore and discover. In this regard, profile AC stated that they *“always had the need to create and discover new realms through art and different technologies”*, while artist A1 said *“at 20 I discovered art as a medium to explore hidden parts of myself. Since then, a long journey of experimentation has begun”*. Artist A3 said that they started with traditional art but has always kept their images and drawing very abstract, an inclination that has mirrored in their digital work, while artist A4 said *“I create art that I enjoy with the hopes of sharing that enjoyment with others. If it makes others excited, that’s a win for me”*.

In a similar fashion, to answer the second part of the question about their actual interaction with art, all artists interviewed stated that their current interaction with art has not changed and that the feelings they look for when making art are still clearly tangible even when they realize digital art.

To quote some of the answers, profile AC said *“what I am searching with art and what I’m searching in art is always the same, the only difference is the medium”*, while artist A1 revealed *“[...] physical art inspires me to transfer art into the digital (realm) through modelling and digital scanning”*, and *“this process (of digitalizing their sculptures and tangible artworks) brings me new enthusiasm”* stating that coordinating a team to digitalize some of their products also challenges their management side.

From my experience and from the opinions I have collected, it is very uncommon for an artist to start doing art to enter the NFT world. In fact, all the interviewees and all of the artists that we can consider forefront in the NFT community, started before NFT was even mentioned on the Internet.

On the other hand, most of the collectors started taking an interest in art with the explosion in popularity of NFT. This is an interesting finding and it will be more deeply discussed in the next chapter.

For instance, collector C1 started taking an interest in art when they first met their significant other, but did not really participate in the art community until NFT became popular. Collector C2 stated *“prior to NFTs I’d never really understood art and certainly hadn’t collected any. I could see the reason why an artist would price and sell art to compensate their time but I couldn’t justify spending money on it myself”*, while collector CM said *“I did*

not delve into NFTs for their art, nor am I an artistic person. The only purely artistic collection in my wallet is collecting digital dust, as I rarely look at it”.

The profile that has identified as an artist and as a consultant gave a similar answer, stating that they started looking into generative art (that is created through coding) because of “*the hot NFT market*” and to improve their coding skills.

It is clear that all the collectors I have interviewed, have taken an interest in art during the NFT frenzy.

The second question asked interviewees why they chose to enter the NFT world, an answer that we can predict from the first question.

2) Why have you decided to enter the NFT's world?

Artists entered the NFT world as a medium to spread their art without limits from others.

The most famous artists that I interviewed started taking an interest in this segment as soon as 2017.

For instance, they stated that they started taking an interest in cryptos in 2017 through a collaboration with one blockchain platform that resulted in a huge reproduction of one of their sculptures about cryptocurrencies. They said “*with this artwork we wanted to talk about the future in its entirety and not just about technology or economics*”. They then added “*I started to take an interest in NFT in 2017 with CryptoKitties and CyberPunks, but the sector was still not developed. Some years later, one of my friends - that is also an artist - told me that cryptoart had a reason to exist in relation to the new movement that was been created and the ecosystem about this world. This winter I practiced my digital skills, creating my first digital artworks, and now I feel like I am at ease in dealing with this segment*”.

Artist A2 stated “*I've decided to enter the NFT world because there are a lot of benefits for artists. 1) There are no gatekeepers, and we can exhibit wherever we want without anyone getting in the way. 2) There are a lot more opportunities available and it's so much easier and cheaper to do even group shows with digital files. 3) For the first time in history, artists can get royalties on secondary sales. 4) Commission rates on sales are lower. 5) Galleries have no control over where we show and whom we sell to. 6) It's early in the game and NFTs are going to change the world and be a part of everything mainstream, just like websites and*

social media are today”, reinforcing the idea that NFT make the art market more accessible not only for collectors, but for artists too.

In this regard, creator A4 stated “[...] *I sold my first art piece and now I’m here to stay. I have the possibility of making a living on this platform as a creator. A dream that is almost unattainable for most artists*”.

While artists may have an artistic drive to enter the NFT market, most of the collectors don’t.

For instance, profile C1 stated *“I started small in Crypto with Doge and some ETH (Ethereum). I had also joined NBA TopShot (a digital collectible marketplace) around the same time. When there was a small crash in the crypto market, a TopShot friend introduced me to NFTs and suggested I move my investment from Coinbase/Robinhood and create a wallet on MM and invest in NFTs. He also suggested I mint “Cool Cats”, which I ended up minting 9 Cool Cats (mint is the process of validating information and creating a new block in the chain, in this case, it means collecting, as Cool Cats have to be minted or acquired to be collected). The value of Cool Cats slowly rose and I slowly sold 8 of them to invest in other projects I was either interested in or hoping to flip for a profit.”*

Profile C2 stated *“I was introduced to NFTs by a friend who had a drop on Nifty Gateway (one of the most popular NFT marketplaces). I didn't fully understand the concept at the time but I wanted to support him so I purchased one of his pieces. This was at a time when Nifty Gateway prices were much lower, so there was less of a financial barrier to entry”.*

Profile CC mentioned one great advantage of NFT saying *“NFT is connected to crypto currency, it doesn't only let you create a piece, but the NFT world lets you have profit out of an art. And create liquidity out of it”.*

In fact, NFT can only be acquired and sold with cryptocurrencies, that also fluctuates and can bring a profit. One collector said that nostalgia for collecting Pokémon cards first drove him to NFT but remained in the segment for profit.

All of the collectors interviewed saw an opportunity of investment in NFT, rather than wanting to expand their art collection, except for collector CA that stated the appealing nature of interactive assets and that they like to collect cryptoart because *“it’s art that can be displayed and no maintenance is required. No sun damage, no water damage, no other damage”.*

5.1.2 The comparison between cryptoart and traditional art

The next two questions have the intent of comprehending what the major similarities and differences between the world of NFT and the world of traditional art are, in regard to what the interviewee is experienced in.

3) What are the major differences, that you experienced, between creating, producing/selling/managing communities about/enjoying etc. digital artworks (both digital and digitalized products) that involve the use of blockchain technology, compared to analog art?

When asked what the main differences are in creating, producing and selling art in the NFT market rather than in the traditional art segment, artists mentioned that NFT offer more possibilities than traditional art and that most of the process can be quickened with this new technology.

For instance, artist A1 mentioned that *“even if my work started in the physical art market, I always used processes like scanning and digital modelling to create my work. Cryptoart cuts most of the processes involved in physical art and I can manage my time better, dedicating most of it to creative exploration of the digital”*, while another stated *“I feel that the digital medium offers more possibilities for an artist than the physical, like animation, 3D, AR art etc. Also, with blockchain technology, an artist can precisely define how and how many artworks the viewer can experience”*.

In a similar fashion, artist A2 talked about the low barriers to enter, mainly talking from an economic point. They also talked about the NFT community and how top developers often collaborate with each other and share information, while in the analog art world artists do not, but they stated that the original developer of a certain code will always have a market advantage among educated buyers. Artist A4 artist stated the ease with which artworks are sold and the price range that is extremely different from analog art. In this regard, they said *“People are willing to spend that in crypto, not so much in cash. Crypto-users are already in the game to gain more money. Another difference is the support. The art community doesn't look favorably on NFTs, so there's a lot of backlashes. On the other hand, I've gotten so much support from the NFT community. They're willing to give feedback and praise whereas the art community was almost stuck up and provided nothing”*.

Similar feelings as the latter response are expressed by the collectors, where the ease of collecting and the security of blockchain are the main differences with analog art. In this regard, collector C1 said *“Digital artworks are all bought online. NBA TopShot/ DapperLabs basically does everything for you and has multiple ways to pay for their product (Eth, Fiat, CC). Analog Trading cards you have to order online or go to a physical store and purchase, usually only Fiat/CC is accepted. For more traditional/decentralized NFTs, it is a bit more complicated to create a secure online wallet, but companies/apps like Coinbase / MetaMask are starting to make it easier. This can be more confusing than just ordering or paying at the store and receiving your artwork/collectible. The other difference is instead of pay tax at the store or purchase for analog online, with digital there is a gas fee to purchase/move things on the blockchain”*. The fee referred is linked to the PoW mentioned in the theoretical framework and the price is paid both by artists and collectors.

Collector CA mentioned volatility as the main difference with analog art and stated that the hype around one item can make its price skyrocket in a matter of minutes.

Collector C3 mentioned that blockchain adds an additional level of security to the owned item, while profile CM mentioned that even if digital art is secured by blockchain, the ease of reproducing a digital artwork is something mildly annoying for a collector.

Interviewee C1 also mentioned that the main difference between digital and analog art is that the first does not have barriers to enter and that digital art and collectibles are so easily *“flipped”* (a term used frequently in the NFT community, meaning that an item can be acquired and sold for a profit) that some people rely on NFT as their main income. He then added *“I find the fact that collectible NFTs can have such interesting, far-reaching applications that can bring unlikely groups of people together simply astounding”*, an important contrast with analog art where most interviewees found gatekeepers and barriers when trying to enter.

The fourth question is similar to the previous one, but with a more general meaning. Interviewees are asked what differentiates digital art from analog art.

While the previous question is directed at the action with which the expert interacts with art (what is the difference between selling analog and digital art?), this question is more abstract and its intent is to understand what change in the concept of art.

4) Which are the major features that differentiate digital art from analog art?

For artists, the main difference has been from the experience's side. In fact, non-materiality is the main characteristic that they mentioned.

For instance, artist A2 said *“(one of the) major features that differentiate digital from analog art (is that) we cannot directly touch, feel, mold the art with our bare hands, as we can do with paint, clay, paper etc.”*, while also adding *“the experience of digital art is limited to the technology available to access it, which is most often a small screen. There is social interaction around digital art, but it feels a little distanced as compared to meeting an artist in a gallery exhibition”*.

Social interaction is a theme that has been mentioned by different interviewees.

Profile AC said that they do not recognize the difference between NFT and traditional to be the same difference between analog and digital art; they explained that they majorly differ because of the tools used to create artworks, wherewith digital art you can *“harness the power of data”*.

Expressing a similar feeling, artist A4 said that they found a lot of analog art in NFT, adding *“[...] you can take photos or scan them (the artworks) in and they count for the digital pieces. In fact, a good scanner makes it almost impossible to differentiate analog art from digital. There are, however, some things that digital cannot recreate, like certain brush strokes or tones”*.

Profile A4 also added that digital art can interact with the environment and change based on where it is been displayed, while profile A3 pointed out that digital art is forever and immutable (hinting the use of blockchain technology), while analog art age and its record can be *“changed or exploited for whatever mean”*.

Artist A1 pointed that *“digital art always existed, however, there are new creative tendencies, similar to the Cyberpunks project, that are closer to the world of decentralization and of gaming”*. They said that *“(digital art) endures many contaminations at its stylistic level, from worlds that were previously borderline, compared to traditional art's borders, and thanks to crypto-art they find a value and a market, something that seemed far away. Cryptoart is a set of different things, but what I find most interesting is the possibility of collecting and enjoying art in a new dimension: the dimension of possibility, of non-materiality's concreteness. Perhaps, (digital art) gives a new vision of what is and what is not matter”*.

Collectors had a similar view of differences between analog and digital art, as most of them cited tangibility and non-materiality as the main properties that differentiate the two, but they see it as an advantage, as far as collecting, opposed to the artists' vision where non-tangibility is just a characteristic.

In this regard, collector C1 said *“personally I find the portability of digital art much more exciting. Analog art takes up space and requires effort to display whereas I find digital art convenient, displaying through online gallery platforms and digital displays. Additionally, I can display the same art in multiple locations - it's simply more flexible”*.

Collector CM expressed similar feelings, stating *“when attempting to answer this question, I try to think of the advantages analog art has over digital. Beyond the weight and substance of physical tangibility or the difficulty of convincing reproduction, I simply cannot think of any advantages that aren't completely shadowed by the advantages digital art brings. Since digital art doesn't take up space and is easily accessible from any device, it is much more convenient than going to an art gallery and buying a painting, not to mention much easier to sell. Beyond this, digital art NFTs can be tied to different functions previously unheard of, due to the flexibility and functionality of the blockchain and smart contracts. [...] Another fascinating way I've seen them (NFT protocols) used is in vIRL NFTs, or virtual in-real-life NFTs. These NFTs represent a real, physical product that can be redeemed through either burning the NFT or using a redeem function smart contract, if the owner wishes to redeem it. In short, it is ownership of a product withholding delivery. So, one could buy a vIRL NFT of a pair of shoes and easily resell it to another buyer without ever having received a delivery for the shoes. I believe innovative applications of digital collectibles such as this will make NFTs play a significant part in our future lives, in ways we would never even think of right now”*.

Profile CC said that digital art has no limitation whatsoever, referring mainly to the creative process, as it is limited by human limits and tangibility, while digital art is not. Collector C3 believes that digital art is superior because owning an NFT can be tied to other perks as generating other NFTs, producing income for the original creator, redeem virtual items. They mostly referred to collectibles rather than artworks as intended in a unique piece of art, but nonetheless these are interesting points of view.

5.1.3 Scarcity

The next two questions involve scarcity as the main theme.

Question number 5 is based on the work of Benjamin and his essay “The Work of Art in the Age of Mechanical Reproduction” (1935) where he states that the ease of reproducing an artwork is changing the value of the artwork itself and that art was never intended for the masses; a socio-economic context that can be seen as similar as today’s one. The question asks experts their opinion on the ease of reproduction and on the change in value that this can involve.

5) Benjamin states that artworks were not originally created for the mass, and only after the age of mechanical reproduction they became "for the mass". Do you think that being able to access artworks more easily can change the value of the artwork? And in which way?

The short answer is no, the ease of reproduction does not change an artwork’s value. That is what most of the artists interviewed thought.

In this regard, artist and collector AC said *“I think there are different things that go into the value of an artwork. Some argue it’s the status of the artist, some argue (it’s) other (characteristics); but I think art is about emotions [...] and if something is great, the intrinsic value does not change over time”*, while artist A2 stated that the mass only accepts and change the value of artworks that fall into the realm of pop culture, and added *“[...] Banksy still sells for high prices, despite being popular”*.

Artist A4 interestingly said *“[...] in America, since the days when America was formed, artists have been fighting for the right to have their pieces valued. Early Americans struggled without the news or media to help spread their pieces around. Nowadays, we have access to an even larger source, the internet. I don’t think it’s changed the value of the artwork. The difference is who notices it and how does it trend now. Even back then, popular works would be remembered and noted. It just took a bit longer to happen. What media has done is removed the barrier for people who are not really skilled in art to try to add their pieces to the game. Likewise, competition is high”*, hinting that the ease of reproduction could be play in favor of artists.

Profile A1 said that they don't believe that the ease of reproduction changes artworks' value because *“what we define as digital art is just images, just like photos of every known artwork that you can look up on your phone”*.

Collectors, likewise, feel that an NFT is more than enough to ensure ownership of digital artwork and drive the demand/supply model.

In this regard, collector C3 said *“Digital art and its convenience has opened up art to a broader audience, just as mechanical reproduction did. A bigger audience in a supply and demand situation would usually mean greater demand and therefore higher prices. That is, unless that digital art is a free jpeg on Google images. Widespread access to digital art initially cheapened the value of said art because there was no sense of ownership and one could simply take the art with a simple cypaste. NFTs provide a sense of ownership, because each NFT has a unique signature on the blockchain that is instantly verifiable and can be connected to functions within the blockchain that give the art an usage case. You could certainly still cypaste the image tied to the NFT, but it would have no place on the blockchain and no potential usage [...]”*; while in a similar fashion, profile AC added *“just like art auctions when there is easy access for the art the demand won't go up, the value won't go up. But when the art is highly demanded and is not of easy access demand, would likely to go up”*.

Collector C2 answered *“I think the exclusivity around traditional art collecting was partly why I never collected art previously. By making art more accessible digitally, I've been able to be a part of communities with other collectors making it feel more welcoming. As more people have access to the art, more people will see and experience it, which drives FOMO (fear of missing out) in those yet to collect and so increases the price. On the flip side, by having more people collecting there are fewer "rules" around how art should be resold, so pricing may be more volatile than in the traditional art world”*.

Expressing similar feelings, other collectors attributed the value of an artwork to the demand/supply mechanism.

Question 6 has scarcity as its main topic. The intent is to understand if a digital passport of ownership can ensure a level of scarcity similar to owning a unique tangible piece of art. Interviewees partially answered this question in the previous answer.

6) Scarcity is still an objective for artists / collectors / developers / creators etc.? And if it is, is there a method to ensure or create scarcity? Can blockchain technology create a level of exclusivity that can contrast the ease of reproducing digital artworks? How does non-materiality affect the artwork in this process?

Artists agree that scarcity is still an objective when creating and selling art, and they believe blockchain technology is sufficient to ensure a trusted level of scarcity.

In this regard, artist A1 said “*NFT shifts the paradigm. NFT can now differentiate the uniqueness of one art piece*”.

Profile AC stated that while they want the most people to see their work, they understand the need of scarcity in the market and they “*think NFT brings the two possibilities together, everyone can see the art, but only a few can be the owner of the art*”, while also adding that “*scarcity is about owning and not seeing*”.

Artist A4 said that “*scarcity is an important aspect of NFT art, that an artist must be thoughtful about*”, while adding that an artwork “*can be copied by screenshot, but won't have the same value as the one which was tokenized. Although it is nonmaterial, it remains exclusive*”.

For collectors scarcity is obviously an important property to have for the items they collect.

Collector C1 stated “*Scarcity is my main metric for art I invest in and I see blockchain technology as essential to that. There is a degree of trust that the artist won't simply create additional collections of the same artwork, but generally the community is aware that this reflects badly on the artist so (it is) self-polices to some extent. Non-materiality is a non-issue in my opinion, where prints exist in the analog art world and can be produced with no real guarantee of scarcity*”. Profile C2 expressed similar feelings, stating that the main problem with digital art is that the actual creator of an artwork can create multiple legit copies of the same artwork, but as you just read, it is not frequent.

Collector C1 also stated that “*There will be fakes whether (they are) analog or digital. The difference with blockchain is that you can trace everything through the blockchain if you want to verify the authenticity of a piece or collection. Do you want to own the actual Mona Lisa or a copy of the Mona Lisa? I think it's kind of flattery to have fakes of one's art, it is in*

high demand if people want to try and reproduce it. Those getting into NFTs and Blockchain need to ensure they are doing their own research to ensure they are buying what they think they are buying”.

Collector CM added “*Scarcity has varying levels of importance for collectors, depending on how popular a collection is or what use case the NFTs have, but in general, yes, scarcity is an objective for collectors. There are several methods to bring about scarcity of NFTs [...] A more innovative way to create scarcity that I've seen is to provide collectors with an incentive to burn their NFTs in pursuit of rewards in burn events, so the NFTs they burn become scarcer, while the top burners receive some other rewards for their sacrifice. The only way I see blockchain creating exclusivity for simple jpeg files is to create smart contract functions that provide some other use or higher form of enjoyment of the art NFT. There is no other way, in my opinion, that blockchains can elevate the exclusivity of something so accessible. "Owning" a 1 of 1 Bepple NFT that cost \$69 million may seem exclusive, but I don't believe that ownership of a digital image with no further exclusive blockchain functionalities or interactions, no matter how much work and time went into the digital art, is at all worth that much money”*, an interesting take with which most of the insiders agree, from my experience.

For instance, collector AC cited the same method to create scarcity, adding that collectors burn their assets because the original creator guarantees another artwork for the burning.

5.1.4 The NFT community

As mentioned in the previous chapter, I found a very tight community around NFT and the same perception can be captured by some of the answers that have been reported. While the community is very active, this does not necessarily mean that can influence work and purchases. The purpose of question number 7 is to understand whether or not the ecosystem around these items can point artists and collectors in one direction or another.

7) Has an ecosystem (as an interlinked network between different subjects) been created around digital art? If it has, how do platforms, forums, communities, affect the process of creating / producing / selling etc. art? Did you observe differences between this type of environment related to digital art and the ones connected to analogic art?

Artists have agreed that there is an ecosystem around NFT, but rather than influencing and affecting the process of creation, the community around NFT helps artists to grow.

For instance, artist A2 stated that “*communities and forums are very active and people are extremely supportive of each other, such that they even suggest techniques and processes creating the art, which the artist may not have thought of earlier. For example, an artist suggested I animate some of my images for the NFTs, which changes the pieces themselves. [...] This happens very rarely in the case of analog art. Also, collectors are not as easily accessible nor as friendly or social in the analog world.*”, while profile A3 that communities are being created around the main marketplaces and they see communities at the centre of NFT’s future.

Artist A4 described the typical process of creating art and understanding the market, as a flow where the art is created and then immediately uploaded to social media; if the art gets some tractions, then the artist will start to produce similar pieces and upload them on a blockchain, otherwise, they will rethink their art. They also stated that this is a similar process to showcasing analog art and understanding a segment in the traditional art market, but it is easier and cheaper due to the lack of physical space needed to show a work of art.

Expressing similar feelings, artist A1 stated that there is an “*entire ecosystem of artists, collectors and observers*” and that “*perhaps because it’s intrinsic of the blockchain’s nature, perhaps because everything is just starting, there is a cut of everything and everyone that is an intermediate, easing the process of bringing enthusiasm without filters*”; they also added that “*there is an important level of liquidity*” in this segment and this is one reason that made this market the most important, as for now, art market.

Collectors expressed a strong sense of belonging toward NFT community.

For collectors, communities are the primary source of information and often drive the value of an artwork. Communities are populated not only by collectors, but by artists too, on this topic collector C3 said “*For the digital art [...] (the community) affected the art in the aspect of marketing/promotion*”, while profile CM said that artists “*use these platforms to formulate ways to increase the value of the art, along with artists being able to incentivize you to hold the art by creating some kind of value as well*”.

Collector C2 stated that the NFT community is what pulled them into collecting art, where “*conversations around collecting happen both in public but also private spaces, adding a level of gratification to collecting certain works*”. It’s clear from my experience too, that the NFT community is really strong and incentivized.

5.1.5 Immateriality and its implications

The 8 question is about the non-materiality of the object and the ways a digital item can be enjoyed. Interviewees were asked where they can find a difference between enjoying analog and digital art, considering that digital art must be enjoyed with a physical device.

The purpose is to understand to what extent digital art can be considered different from analog art. This is an important perspective, and it is mentioned in the theoretical framework of the project, because digital items are, for now, tied to physical objects.

8) Considering that digital art needs a device to be enjoyed, where is the difference between enjoying digital and analogic art? Is digital art an evolution of enjoying art or is it a new opportunity for the art world where digital art can take a different direction compared to the more "traditional" art? In which way?

Artists agree that digital art needs a physical device, but they argue about the ubiquity of digital artworks.

Artist A2 said *“digital art does need a device to be enjoyed but uses the device to be more accessible to a wider arrange of people, which has never happened with physical art. In fact, during lockdowns, devices were the only way to access even physical works”*, while profile AC stated that *“this is only a new medium”*.

On a similar note, artist A4 stated *“Whether you’re drawing on a digital tablet or computer or creating photos, painting, sketching, etc., there isn’t truly a difference in enjoying the art. Everyone has a style or niche and that applies to both analog and digital. Digital art is probably 10-15 years old at this point. I remember when Wacoms (graphic tablets) first became a thing. I think the only real difference is where people enjoy art now. People have been liking and saving art pieces forever on the Internet”*.

As for the second part of the answer, artists see digital art and NFT as a new opportunity for art that is detached from traditional art. For instance, profile A2 said *“Digital art is not an evolution of physical art, it’s a different form of art, like how a painting is different from sculpture and they’re both different from installation. All of them will coexist with digital / NFT art. It is definitely a new opportunity for artists, and thankfully a direction that forks away from traditional art and its repressive systems. My guess is it will run parallel to the traditional art world and converge at some points with physical gallery exhibitions”*.

Artist and collector AC said that the separation between digital art and traditional art reminded them of when photography was not considered art. They stated that digital art is a new medium, a new tool and NFT are a new form of authentication, but they are simply another branch of art. It is clear that artists do not think of NFT as a new form of expression, but they attribute to them art-like properties.

Likewise, collectors expressed similar feelings.

Profile C1 had an interesting take about the showcase of digital art, stating *“I think this started with digital portrait frames right, people wanted to share multiple photos in their house by uploading an album and it circles through all the photos. I think this is slowly evolving with companies such as NiftySlabs who create physical cards of NFTs. There is another company that does similar to digital photo frames where you upload your NFTs. There are also online galleries you can make and share with social media or via email to people all over. I believe we all love the art we buy but we want to in general share it and show it off”*.

Similarly, collector C3 said *“I think the difference where one could enjoy the art is the way the art is presented: analogic art could be felt while digital art can only be seen or heard. It is certainly a new opportunity for every artist since it is a new technique and everyone can discover their own style and be good at it. I think they'll move sideways though, both of them have their own market. Perhaps the traditional art would be for the mass of people but they cannot own it. However, digital art can go up because of the marketing and people's demand”*.

Collector CM pointed out that the main difference with traditional art is that he does not collect for artistic enjoyment, saying *“I personally don't view NFTs as something I collect for just their artistic value, and I still wouldn't be comfortable doing so”*.

One interesting take from a profile C2 is that digital art can allow new forms of enjoyment, they stated *“My first true appreciation of a viewing digital art piece was when I experienced it in an online VR/3D gallery. I was able to "walk" up to the art and see its detail up close and as far as my senses were concerned, I was there. Digital art can be infinitely more enjoyable due to being portable, or through its use of mixed media. Simply hanging a digital screen on a wall and displaying an image is a low-effort solution and comparable to*

displaying analog wall art, but with the ability to interact with digital art, moving around or even through it, it can make for a much more exciting experience”.

5.1.6 On the potential of NFT

The last question, as mentioned in the previous chapter, had not a specific purpose.

Instead, the objective was to let the interviewee feel free to depict what they see in the future of NFT.

While most of the questions had similar answers from different profiles, the answers to these questions are all diverse, in length (some answers are one sentence long) and in content.

9) *What is the potential of digital art and the interaction between art and blockchain technology?*

Some artists believe that the NFT segment is just another market.

For instance, artist A4 said *“To be honest, view NFTs as almost a market of sorts. People are selling their art. Collectors are buying it. They may turn it around for profit or hold onto it. This is a concept that’s age as old as time. It’s just digital now. NFTs I believe will continue to be around and take off”*, stating that the only growth they can see for NFT is in popularity. Artist A3 expressed similar feelings, saying that NFT unveiled a new different branch for art and digital items, with art becoming interactive and with authenticity linked to the chain, all concepts that we are all aware of.

Artist A2 said that it will depend on the new interactions with the blockchain and if this technology has already exploited its potential, stating *“[...] we will only know what's possible when artists innovate with blockchain technology. For example, generative art like CryptoKitties and CryptoPunks were big innovations, but the numerous similar projects that followed were merely conceptual copies. When somebody uses blockchain technology in a way that it has never been used before, it will become art [...] but we cannot tell at this stage”*.

One interesting take comes from artist A1 that stated *“I believe the collector of the future, and if we are talking about future then we are talking about infinite time, will perceive a digital object in the same way we now perceive physical items, therefore, there will not be any difference between digital and physical. Perhaps, digital will have more value, as it is more fluid, light and because of its method of certification. I believe that digital art will find*

more and more space and it will become more and more valuable, reaching the levels similar or higher than tangible art, with digital museums of high prestige and regard”.

Some collectors were very prudent with their answers, with collector C3 stating that *“we are becoming more digital from paying bills to transferring money to investments, hence, the digital art has a great potential since these are also assets. Blockchain technology is one of the major moving paperless transactions so they could be correlated and by that if one has a potential the other will follow”*, while profile CM said *“NFTs that only give artistic value are probably in a bubble right now, but even when that bubble bursts, a lot of art NFTs will still be worth a few cents, which is more than you can say about simple jpegs. Pieces like Beeple's NFT will most likely retain a lot more value because of its notoriety and prestige, and the fact that NFTs can inspire such a view of an art piece shows how blockchain technology is a legitimate medium of art and its exchange of value”*.

Collector C1 was very brief and concise, only saying that the potential is unlimited.

Collector C2 had an interesting take, saying *“I don't think we're even close to understanding the potential yet but even at a basic level, being able to add utility to digital art beyond the visuals is going to be massive. With blockchain technology, an artist could very easily gift (airdrop) additional art to existing holders of their work. Or by holding a particular piece, give access to an experience, whether digitally or in real life”*.

Expressing similar feelings, collector CA stated that they do not *“believe NFT has reached their potential, the metaverse is still being built. More VR capabilities will come out, with platforms and wallets interacting with them. NFT will come to life being displayed wherever you wish”*.

This is the only question that gave mixed answers, but had no context borders and its purpose was to understand the perspective of insiders without limiting their thinking.

In the next chapter, these answers will be briefly discussed and then compared to this project's theoretical framework, to better understand where academic literature can be improved.

6. DISCUSSION

Throughout this document, the main intent has been to understand whether Blockchain technology can overcome the limits and challenges of digital artifacts, to allow the proliferation of an art market that is digital and online. This chapter's objective is the result of the work collected and processed in the past months.

6.1 ANALYSIS AND PERSONAL CONTRIBUTION

In the next pages, the results of the previous chapter, in addition to secondary data, will be compared to theories and models about digital artifacts, ease of reproduction and distributed ledgers. Every group of answers obtained from experts will be analyzed and commented on, outlining the main evidence that they comport. To facilitate the reading and maintain the most pristine level of coherence and clarity, the analysis of answers will follow the categorization of the previous chapter.

6.1.1 The main drives to enter the NFT market

The first two questions of the interview have been crucial to identify the profile of interviewees and give some fundamental insights about the NFT community.

In particular, it is clear that creators have been driven by their artistic instinct and impulse to create art, while collectors have entered the segment mainly because of the possibility of economic exploitation.

Whether it is not very legible in answers to the first question, answers to the second clear any doubt. Collectors of NFT are not art collectors, but rather collectors of what is defined as “collectibles” and can bring a profit.

This explains why NFT are also referred to as cryptocollectibles.

To be specific, it is explicit in some of the answers that have been collected from collectors, where they talk about “flipping” art and “flippers”.

To “flip” an artwork, or a collectible, is the action of buying a piece of art to simply resell it at a higher value, at some point in time.

From my personal experience, this can be applied to collectors at every level. It is certainly not a secret, but the market works for both parties: artists can sell their work, collectors have found a new form of storage for their capital.

One of the biggest collectors in the world, created a cryptocurrency that is backed by their collection or, as they refer to it, their “vault”. The vault is worth, at the time of writing, more than \$47 million, but costed \$2 million to collect, an amount of money spent over the last 2 years (whale.me; 2021). It is clear that acquiring more than 13 thousand digital collectibles to use to back their own crypto-currency, and to generate an increase of over 2300% in value, always had a speculative intent rather than an artistic goal.

While owning the cryptocurrency of the vault, however, holders can rent the assets contained in the collection and can have access to exclusive NFT.

I believe there are different reasons to explain why the NFT market is so popular to store capital.

The first reason has been actually mentioned in the theoretical framework of the project: Chohan (2021) argues that, in the last months, sums of capital have been distributed to the population through stimulus checks, a social and financial measure that caused some people to have capital to store.

For the U.S. government, stimulus checks increased the economic output by about 0.6% (The Congressional Budget Office; 2021). While the first stimulus was used as much as 75%, the second and third were spent for approximately 20% of their value (Forbes; 2021).

Cryptoart and cryptocollectibles are less volatile than cryptocurrencies, they do not entirely depend on the market and they do not influence each other in a critical manner (while cryptocurrencies are mostly linked to Bitcoin’s value, even if they do not operate on the same Blockchain). The problem with cryptoart is that there is not a predetermined value for the items purchased. A collector can buy an artifact for an Ethereum, but could no longer be able to sell at the same price.

While cryptocollectibles often rely on scarcity and a semi-structured economy defined by the platforms they are based on, cryptoart uses the same mechanisms as traditional art: the price of an artwork is entirely based on what another collector is willing to pay.

Another reason I reckon is the new highs reached by cryptocurrencies, but we have to make a distinction of when cryptocurrencies raise cryptoart’s popularity and when cryptoart raise the value of cryptocurrencies.

For instance, the surge of Bitcoin at the end of 2020 may have helped cryptoart to gain interest among actors.

On the other hand, Bitcoin and other cryptocurrencies reached their highest ever peak when the hype around NFT was at its apex. On April 14th, 2021, a Bitcoin was valued at more than \$64.000/coin (Yahoo Finance; 2021), while Ethereum reached its peak in mid-May with a value of over \$4.000/coin (Yahoo Finance; 2021).

To provide more context, at the time of writing Bitcoin and Ethereum's values have decreased by about 30% and 25%; while since January, every month NFT registered a higher volume and value of assets sold than the prior month. Cryptocurrencies are the main assets that back cryptoart and cryptocollectibles, therefore it is clear that their progress is influenced by one another.

Another reason for NFT popularity can be seen in the traction gained by the online community.

Communities around NFT are created every other day on different platforms and social media. Twitter is the showcase for important profiles, Reddit and Discord are the communities to discuss what is new and to promote art, blogs and forums are the main environments to ask for advice.

Online communities are powerful and can bring together different people for a common purpose. We all remember the GME frenzy at the beginning of the year, when the analysis of one single user brought together millions of stock traders and rose the price of the gaming company from a couple of dollars to hundreds of dollars.

At the time of writing, \$GME is still traded at around \$200, an annual increase of 2100% (Yahoo Finance; 2021). This does not mean that online communities manipulate the market (even if, they can), but that information is constantly shared on the Internet and the most valuable assets are always acknowledged.

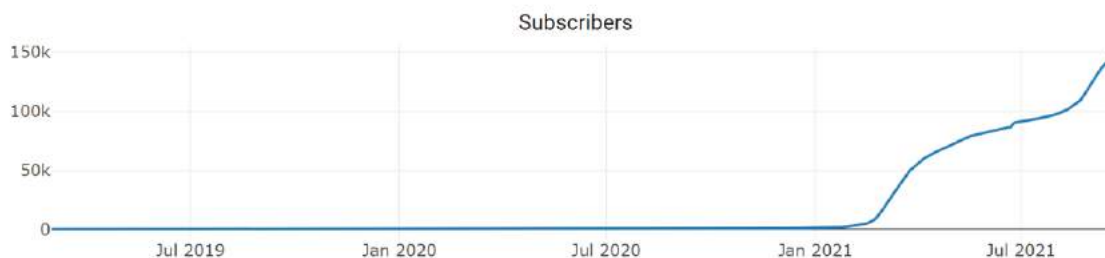


Figure 6. r/NFT subscribers Jul 2019-Jul 2021. (subredditstats.com; 2021).

One last reason to understand the popularity of NFT is the ease of accessing the market, both for artists and collectors.

As stated by the interviewees, entering the market and selling a piece is extremely easier than in the traditional art world, where gatekeeping is a diffuse practice. Digital art is easier to market because everyone has a window.

All artists need is to create a profile with one of the main platforms, pay the fee to upload their work and then spread the rumor.

We have seen this type of mechanism for traditional art too, especially in the last few years, when traditional artists upload images of their work online. The difference between analog and digital is that there is no intended online marketplace for physical art; if one collector wants to buy a tangible piece, they have to research the artists, while NFT platforms hold the entirety of artists. Moreover, the economic power that is needed to enter the NFT segment is lower than in traditional art.

6.1.2 Analogies and differences between digital and analog art

Questions 3 and 4 had the purpose of understanding in what way digital art differs from traditional art. The questions were not about NFT specifically, but rather about the processing involving an artwork.

As a matter of fact, it is specified, in both the questions and the introduction to the interview, that “digital art” means digital and digitalized products, with the latter being digital reproductions of some tangible art (e.g., Florence’s Uffizi Gallery sold a digitalized version of Michelangelo’s “Tondo Doni”).

Readers have to be mindful of the main topic of this paragraph, which is about digital art and not NFT.

Artists and collectors found the main difference, between digital and analog art, in the non-materiality of the product.

Artists agree to find convenient working with digital procedures, where times are cut and where editability is one of the main properties of the creation process.

This freedom of creating and ease of producing has been also referred to as automation (Manovich, 2001), the ability to remove human operations from the creation process. For instance, Kallinikos, Aaltonen and Marton (2013) mention a similar property, calling it “editability”, as one of the main characteristics of digital artifacts, that can be modified by adding, deleting, rearranging certain elements.

It has to be reminded, however, that NFT are not editable, because once a digital item is registered on the blockchain, it is immutable by definition.



Figure 7. Digitalized version of Tondo Doni. (Michelangelo Buonarroti; 1504-1506).

Another interesting take from answers to these questions is when one collector talked about interactivity with digital artworks and that only when they enjoyed some NFT with virtual reality, they truly comprehended the potential of NFT.

This type of behavior falls under two categories: interactivity, a property mentioned by Kallinikos, Aaltonen and Marton (2013) that differs from editability because it does not allow modification of the asset, but rather information exploration, and communicability (Yoo; 2010), the property of interacting with actors in a digital ecosystem.

Collectors often mentioned accessibility and ubiquity as the two main properties that differentiate collecting physical tangible art ad cryptoart, explaining that the latter, being online, can be showcased anywhere without effort.

6.1.3 Scarcity and the ease of reproduction

Questions number 5 and 6 are about scarcity and the ease of reproduction.

These two questions are fundamental for the project's purpose and refer to the main limitations of digital artifacts in terms of the ability to be collected.

Artists and collectors have answered in a similar fashion and, as it was predictable, agree that blockchain technology can ensure a level of immutable scarcity that can be trusted.

Digital artifacts are ubiquitous, infinitely replicable, abundant. This is the main problem with collecting and archiving them (Kallinikos, Aaltonen and Marton; 2013).

Blockchain technology helps solve this problem in an extremely simple manner: by attaching an immutable digital passport to the asset. Blockchain technology is immutable (Zheng, Xie, Dai; 2018) and its integrity is the perfect property to add to a digital artifact.

With the addition of the digital passport, blockchain technology supply a level of trust and transparency that no other structure could supply.

As previously reported, more than one collector noted that the technology makes them feel safe and that blockchain technology ensures a reliable state of scarcity and a reliable proof of authentication, two characteristics that are interrelated.

Due to the properties of digital items, one file can be copied with a click of your mouse and that by pasting the asset in another directory, all the previous information can be lost.

Cryptoart and cryptocollectibles combine the unique properties of digital artifacts and blockchain ledger to create a digital item that is nearly perfect.

Nearly because blockchain does not provide a level of protection against copying an artwork. As Trautman (2021) stated, in fact, we own close to nothing online.

Artist A2 noted that the ease of reproduction helps the artist in increasing the popularity of their work with no consequences under the condition that blockchain technology is applied and the original artwork is traced. In a similar fashion, collector CM outlined that digital reproduction did the exact same thing as mechanical reproduction in providing a broader audience for artists (Benjamin; 1935) and that a bigger audience usually means a higher value for the artwork, in the simple mechanism of demand/supply. As interviewee AC stated, NFT combine the need for an artist to spread their artwork, by being digital artifacts, and the need for a buyer to ensure ownership, by being tied to a blockchain.

One interesting facet has been noted by collector C1 by mentioning that artists can sell the exact same piece multiple times. This practice is completely legal and each different copy is being registered on the blockchain with its own personal record. They also added, however, that the market itself regulates these types of behavior, because an artist that is known to produce more than one copy of the same artwork usually doesn't have a high consideration in the segment.

The practise is common in the cryptocollectibles segment, where different collectors own copies of the same piece. However, it is not an intrinsic practice of cryptocollectibles, but rather of collectibles. In taking trading cards structures as an example, we can see the same pattern. Every copy of a trading card is authentic and identical, and its value is mainly based on the availability of the card. The same logic applies to cryptocollectibles.

It is common knowledge that the original Beeple that has been sold for \$69 million is property of MetaKovan, one of the most renowned collectors in the game, but this does not stop me from displaying the same exact artwork in my living room, and you would be wrong in thinking otherwise. As collector C1 noted, however, you can display a copy of the Mona Lisa by Leonardo Da Vinci in your living room too and it can be identical to the original kept at Louvre Museum in Paris. Would you have the same artwork as the Louvre? They would be identical, but they would not be the same piece. In a similar fashion, an immutable record of ownership ensures the value of an artwork and its scarcity is preserved.

This take is similar to Benjamin's contribution about aura and authority, The German critic, in fact, stated during his essay that even a perfect copy of an artwork, cannot be compared to the original, because it lacks its "presence in time and space".

6.1.4 Platforms, ecosystems and platform ecosystems

Question number 7 is about the environment in which NFT has been developing.

From my personal experience, I noted a very cohesive community and the question emerged naturally: does the community influence the market?

Answers from both artists and collectors agreed that the community does affect digital art and all its implication, but also noted that the same mechanism is triggered in the traditional art world.

To understand the growth of the NFT community we can simply look at its subreddit.

Reddit is a social network that is divided into communities, where each community is called a “subreddit” and has its own topic of discussion.

The community about NFT had less than 2 thousand subscribers at the end of January, it now has more than 140 thousand subscribers. It is obvious that as the popularity NFT rose, their community followed. It is less obvious that the community is helpful to entry-level artists and collectors and can influence the market. It seems odd that some thousand people on the Internet could influence a market that generates worth for billion dollars per week, but we mentioned the GME frenzy and that is exactly what happened.

The majority of artists noted that the community is extremely supportive and that it is not rare to find other members who suggest techniques and creation processes to improve one’s work. Artist A4 also stated that is common for developers of blockchain applications to share code and that there is a high level of respect and credit is nearly always mentioned. Collectors mentioned communities to influence the value of certain artworks and to help mainly under the promotion/marketing aspect of the segment.

Artist A1 interestingly stated that, perhaps because it is intrinsic to the blockchain’s nature, the ecosystem around NFT has cut the intermediate role. This is simultaneously true and false. For instance, there is a third actor in the NFT ecosystem that is represented by marketplaces.

NFT marketplaces perfectly fall under the definition of a platform ecosystem by Van Alstyne, Parker and Choudary (2016); hence, there are intermediates that operate in the NFT community: platforms developers and owners.

We can define a platform ecosystem as the structure where producers (in our scenario, artists) and consumers (collectors) meet.

In our own case, these platforms operate on the blockchain and register NFT; they are basically the managers of the network and this explains the cost for artists and collectors to upload and buy digital assets (they have to cover the Proof of Work).

However, NFT platforms do not interfere with the market and only provide the structure to make the contracts work. In addition, marketplaces know that their most valuable assets are the users and that they need to focus on the ecosystem’s wellness rather than on customer’s value.

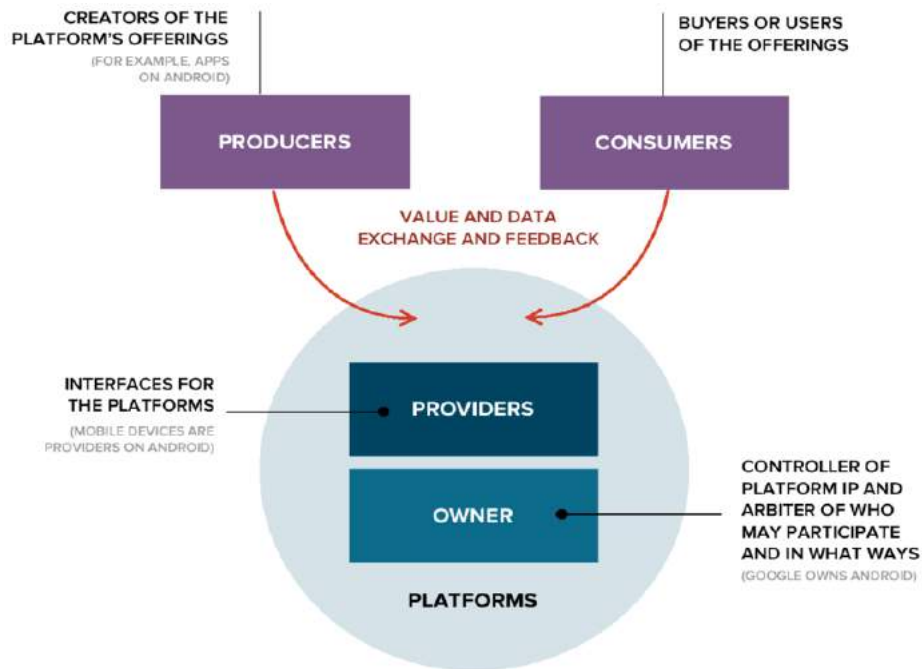


Figure 8. Platform ecosystem model. (Van Alstyne, Parker and Choudary; 2016).

This is why the prior statement is simultaneously true and false: there is an intermediate, but it is there to create an environment in which exchanges are possible.

On the other hand, in the traditional art world, where an underline platform that supports a network is not needed, intermediates work exclusively for a profit and they are disposable. NFT marketplaces are not.

6.1.5 Immateriality and the quality of the artwork

Question number 8 is on the immateriality of digital objects and their link with physical devices. Artists and collectors partially answered this question in previous segments and agree that what differentiates the enjoyment of digital art from the enjoyment of physical art is mainly the ubiquity of the product.

Ubiquity is not tied to digital objects only and, as an artist mentioned, during lockdowns caused by the Covid-19 sanitary emergency, the only method to visit museums, galleries and exhibitions has been with digital technology.

When talking about NFT, in fact, it may be possible to forget about digitalized products (as mentioned before, Michelangelo's "Tondo Doni" has been sold by Uffizzi Gallery, but the same gallery sold other pieces too). It is a great way to own a masterpiece and exhibit it in one's private collection. Moreover, artists can create NFT by scanning their tangible artworks; this is the preferred method of creating for one of the artists I interviewed.

In a similar fashion, Magaudda (2011), states that digital music consumption “(does) not mean less materiality and (does) not imply a less relevant social role for material objects within consumption processes.” He concludes that “material ‘stuffs’ still occupy a relevant position, and materiality seems to ‘bite back,’ playing an even more essential role in consumer practices” (Mardon and Belk, 2018).

All this innovation can be primarily classified as product innovation and thus we can say that digitization, the encoding of analog information into digital format, makes physical products programmable, addressable, sensible, communicable, memorable, traceable, associable (Yoo, 2010).

Digital objects are, for now, deeply linked with physical objects: to read an e-book, an e-book reader is required; to listen to music on streaming platforms, headphones are required. Indeed, while the term “dematerialization” is often used to refer to the shift from physical, tangible items toward intangible digital consumption objects (e.g., Bardhi, Eckhart; 2017. Belk; 2013. Magaudda; 2011), it is broadly acknowledged by multiple scholars that digital items are not entirely “immaterial”.

Collectors agree that there is no real difference in enjoying physical and digital art, rather than the disposability of one artwork wherever you are. Collector C1 interestingly noted that some companies print digital NFT to be showcased.

The immateriality of the artwork brings to the extreme the concept of “exhibition value”, which is the main contribution that Benjamin recognizes to the masses. In his essay, Benjamin states that when an artwork loses its cult value, gains exhibitions value and can be seen in different museums, galleries, exhibitions, shifting the original intent of art, that is not anymore ritualistic, but rather aesthetic. This shift in purpose, give new meanings and characteristic to art.

With ubiquity being one of the main properties of NFT, the exhibition value of an artwork cannot be more stressed. However, it can have positive reflections, as stated by collector C2 when they said “*I think the exclusivity around traditional art collecting was partly why I never collected art previously. By making art more accessible digitally, I've been able to be a part of communities with other collectors making it feel more welcoming*”.

A similar feeling about the ease of reproduction is made in Benjamin’s essay, when he states that the ease of reproduction has a positive effect in allowing virtually anyone to be an artist.

Another concept influenced by non-materiality that we can find in Benjamin's essay is the comparison between contemplating and distraction. While in its project, Benjamin states that distraction is the new form of enjoyment for the masses (that want to bring everything closer), it is true that in 1935 paintings were still meant to be viewed by few people at the same time.

Digital paintings can be enjoyed by millions of people at the same time, reinforcing the concept of value shifting in Benjamin. However, immateriality also implies interactivity thanks to new technologies.

On this topic, one interesting take, mentioned before in this chapter, is the virtual reality experience. Collector C2 said that he truly understood the concept of digital art when he had the possibility to walk through some art pieces. This is an interesting approach to the digital world and could be applied to tangible art too, with a combination of scanning and digitally recreating. Another profile mentioned that digital art can be changed and modelled based on the environment and the location where the art is.

Regarding the properties of immateriality, one question that can be raised is about the quality of the object. While conceptually a collector buys the original artwork, practically they buy the certified copy uploaded by the artist.

Is the NFT the same quality as the artwork?

We have to distinguish two moments to understand if the quality of an NFT matches the quality of the original artwork: first, when collectors view the artwork displayed on NFT marketplaces; second, when collectors own the artwork.

In the first case, the quality of the image is not the same quality as the artwork. For problems regarding mainly the size of a website, collectors are presented with a "preview" of the artwork.

In the second case, the quality of the original artwork is preserved and collectors can enjoy the asset with the same quality as it was conceived.

Discussion about the quality of an NFT also raises questions about the size and format of an NFT.

Can an artwork of every size and format be uploaded as an NFT?

The answer is that it entirely depends on the specific regulations of a platform.

Usually, platforms allow the uploading of images, audio, videos, and 3D models as NFT.

Formats supported vary across the different marketplaces.

In a similar fashion, the size of an NFT varies upon the chosen platform.

A table with examples from different marketplaces, of size and formats supported, is provided.

PLATFORM	MAXIMUM SIZE	FORMATS SUPPORTED
Opensea.io	40 MB	JPG, PNG, GIF, SVG, MP4, WEBM, MP3, WAV, OGG, GLB, GLTF
Foundation.app	50 MB	JPG, PNG, MP4, GLTF, GLB, MP3, FLAC, WAV.
Mintbase.io	16 MB	PNG, GIF, JPG, PDF, OGG, MP3, MP4.
Superrare.com	50 MB	JPG, PNG, GIF, SVG, MP4, WEBM, MP3, WAV, OGG, GLB, GLTF

Table 2. Different platforms' supported files. (Opensea.io, Foundation.app, Mitnbase.io, Superrare.com; 2021).

All these intrinsic properties of digital objects can be gathered under some of the labels outlined in the theoretical models proposed in previous chapters. For instance, the answers show that cryptoart is senseable (Yoo, 2010) and associable (Ekbia, 2009), because it can be aware of the context, interact with the environment and carry information related to places and actors; moreover, it is ubiquitous and self-referent (Yoo, Henfridsson, Lyytinen, 2010), meaning that has to be operated with digital technology. In addition, Kallinikos, Aaltonen and Marton (2013), mentioned the interdependency of digital objects with other entities in large digital ecosystems, reinforcing the theory that digital objects need digital technology and Manovich (2001) that the computer layer of a digital object influences the cultural layers of it.

6.1.6 The future of Non-Fungible Tokens

As mentioned multiple times in the previous chapters, question number 9 had no specific purpose and does not have theoretical implications.

However, it is interesting to note what insiders think of the market in which they operate. One fascinating take is in the artists' section, where profile A1 talks about infinity and that someday digital objects will be perceived in the same way we perceive analog assets today. I agree with their opinion and think that through augmented and virtual reality, digital art will bring to observers an experience that today is not comprehensible.

One of the most thoughtful answers regards the evolution blockchain technology; artist A2 said that we cannot predict what future implications NFT will bring, but they will head where blockchain technology is headed. I agree with their opinion and I think that this answer outline one major problem: where is blockchain headed? And more in detail, where is the size of different blockchain headed?

We know from theoretical implication (Nakamoto; 2008. Lee Kuo Chuen; 2015) that most of the nodes of a blockchain carry information about the whole blockchain (one block carries information from the previous, that carries information from the previous, and so on), so the size of a blockchain is a real issue.

The biggest blockchain at the moment is Ethereum, which is near the 1 TB mark (at the time of writing, the ledger's size is over 975 GB) and has nearly doubled in size compared to one year ago. While Bitcoin's blockchain is used mainly for transactions involving its cryptocurrency, Ethereum is the most used network for other applications.

Most NFT are traded on the Ethereum blockchain, for example, and the chain is estimated to grow at a 3x rate compared to Bitcoin's blockchain.

As of today, the hope is that technology will keep pace with Moore's law about microchips - the observation that the number of transistors in a dense integrated circuit (IC) doubles about every two years (Moore; 1965, 1975) - but experts are skeptical. It is believed that the solution to this problem, which is unknown as of today, lies in the granularity of the network.

Moreover, the size of the blockchain is connected to environmental problems. In fact, blockchain is an extremely energy-consuming technology (De Vries; 2018) and the energy consumed by the network is directly proportional to its size.

Answering this question, collector CM mentioned that they believe cryptoart is in a bubble right now. This is the opinion of different sources and it is the opinion of scholars and experts not only related to the NFT segment, but to the whole cryptocurrency market and the stock market.

Even though cryptocurrencies are decentralized entities, empirical findings demonstrate that they reflect the behavior of the economy and the stock market (Forbes, 2020), but the opposite is also true: the stock market reflects the behavior of cryptocurrencies. Whether or not these three markets are in a bubble or not, it will be confirmed by posters.

It is true that while both the stock market and the cryptocurrency market endured an adjustment in the last months, cryptoart's market continues to grow every month. It is also true that Opensea (Opensea.io, 2021) reported exchanges of NFT to be driven by secondary sales in the month of August.

As of today, it is improbable to determine if the bubble is real and if it will burst, but it is reasonable to think that NFT frenzy inflated the value of the segment.

6.2 IMPLIED NFT PROPERTIES

Given that NFT are the combination of a digital asset and a certificate registered on a distributed ledger, and both these assets have a theoretical model that describes them, that answers from experts have identified what are the main characteristic of NFT and that, since they are a fairly new application, there is not a theoretical model that could describe them, in the next paragraph, properties of NFT will be summarized to better understand the possibilities these items can generate.

NFT obviously share some properties with the information registered on blockchains and some with digital artifacts. In particular, NFT are

- **Immutable and incorruptible:** once an NFT code is registered on the blockchain and confirmed by other peers, the information cannot be changed (Lamport; 1982. Nakamoto; 2008). Everything that is stored on a blockchain cannot be modified, to the utmost it can be deleted by the owner. To delete a Non-Fungible Token, the owner has to send it to the “burn address” of the blockchain, an address that can be considered as a black hole for data. It is the only way to effectively eliminate data from the blockchain, but it is necessary that the owner of the item does so. One collector mentioned burning as a way to create scarcity. These properties include indivisibility and uneditability for the item recorded.

- Authentic: the level of trust provided by blockchain technology can ensure that every digital asset recorded on the ledger is authentic.
- Unique: it is intrinsic in blockchain's nature that every data recorded on the network is unique and different compared to other data. This applies to every item recorded on the blockchain too. Every digital asset that is linked with a digital passport recorded on these public ledgers cannot be equal to any other asset. Even when an artist creates two identical items, their passports differentiate them.
- Traceable and transparent: in space and in time. Data recorded on the blockchain is immutable, transparent and integer (Zheng, Xie, Dai; 2018), hence, digital items recorded on the blockchain are traceable and every transaction that involves them is registered.
- Unreproducible and scarce: every asset record on the blockchain cannot be reproduced. Combining irreproducibility with uniqueness and immutability, every item recorded can be considered scarce.
- Immaterial: NFT are, in fact, not composed of matter.
- Transferable: being digital objects and linked to the blockchain, NFT are online. As online items, NFT can be showcased by simply accessing the wallet in which are contained, from any device, anywhere.
- Self-referent: this is a property derived from digital objects. A digital item is self-referent when they require digital technology to be operated, created, produced, stored, modified, etc. (Yoo, Henfridsson, Lyytinen; 2010).
- Communicable and senseable: two properties that fall under the same umbrella of interactivity (Yoo; 2010). As mentioned by one of the interviewees, NFT can adapt based on location. Moreover, some tokens perform actions based on the ownership of the token itself; we mentioned the social token of Whale Vault as an example. These properties are all grouped under automation.
- Memorizable and associable: NFT as the combination of a digital asset and a digital passport, can, in fact, store data for every transaction in which they were ever involved. These properties are complemented by traceability (Yoo; 2010)
- Granular: a property that blockchains and digital artifacts share. Granularity refers to the minute size of the components of an asset.

The biggest challenges for digital collectibles have always been traceability, scarcity and authenticity. Blockchain technology overcomes all the limits of a digital artifact and allows the collection of digital assets.

Moreover, blockchain solves the two main problems of archiving digital objects, both noted by Kallinikos, Aaltonen, Marton (2013). The authors state that provenance and authenticity are the two main problems when archiving digital artifacts.

With NFT being traceable and immutable, authenticity is guaranteed and provenance can be traced thanks to records on the ledger.

In the end, it is safe to say that NFT are more stable and bounded compared to simple digital artifacts and that blockchain then offers solutions to what scholars had identified as the problem. However, throughout the document is clear that the future of blockchain technology is unclear and that the size of the network is an unsolved issue.

For these reasons I cannot state that NFT afford the plentitude and stability of digital objects nor I can state that these records will be permanent because, as stated by other scholars (Kallinikos, Aaltonen, Marton; 2013), the technology that now permits to archive these artifacts, may not be accessible or adapted in the future.

7. CONCLUSIONS

The final chapter is devoted to conclusions and recommendations for future research. A summary of the last two chapters and their comparison with existing literature are provided.

7.1 RESEARCH SUMMARY

To better understand the results of the project, findings and insights are compared to the main research purpose and the underlying research questions.

The intent of this project was to answer the question:

- *Can blockchain technology overcome the limits and challenges of digital artifacts?*

Different variables have to be taken into account when trying to answer this question.

First, the project is contextualized in the art and collectibles segment, empirical findings could not be true in other environments.

Second, answers have been collected from a sample of interviewees. However, the sample has shown consistency in the answers and conclusions can be drawn.

For instance, the simple answer to the main research question is: yes, blockchain technology can (and do) overcome the limits of digital artifacts.

In detail, the main problem outlined in the theoretical framework is about archiving digital assets.

NFT, as digital immutable certificates of ownership, allow digital assets to be archived, stored and collected. For instance, provenance and traceability are properties intrinsic of NFT. Combined with the immutability of data, these new assets allowed the proliferation of a market that can be compared to the traditional art market.

This take partially clear doubts about a *comparison between cryptoart and traditional art*. However, the two markets are not perfectly comparable in every aspect and contributions throughout the document highlighted *advantages, disadvantages and differences between analog art and the NFT segment*.

For instance, artists and collectors both noted that in terms of participation, accessibility, and community, the NFT market is a better choice compared to the traditional market, where gatekeeping is a diffuse practice and the entry barriers are usually high.

In the context of archiving, all the profiles agreed that NFT provide a level of trust more than sufficient to collect. This property, intrinsic of the blockchain, contrasts some properties intrinsic of digital artifacts, in particular the lack of an authenticity certificate. It has to be clear, however, that NFT provide a certificate of ownership, not of copyright. For this reason, cryptoart can still be reproduced infinitely, but the original artwork remains unique.

This last paragraph clears any doubt about the *state of scarcity in the NFT market*. In fact, in the document, the main implicit doubt has always been:

➤ *Can blockchain technology create a reliable state of scarcity?*

The short answer is yes. The technology behind distributed decentralized ledgers is immutable and incorruptible, thus ensuring a level of scarcity in the segment that is more than sufficient. NFT are unique and cannot be falsified. The only issue can be related to the possibility for an artist to sell the same artwork tied to different NFT. Every owner would own a copy of the original artwork, but the technology underlying the assets would make the pieces non-interchangeable. There are two considerations to make about this practice: the first one is that this property is not intrinsic of digital art, the same thing can happen in the traditional art market with one artist creating copies of the same piece. Second, as one collector stated, the valuation of an artist depends on this type of behaviors and, therefore, it is not a common practice.

In terms of creation, artists noted that digital art is more easily accessible, less expensive and can cut time in some actions within the production process.

In the context of selling, buying and showcasing, all profiles agreed that non-materiality provides artworks with the property of ubiquity, facilitating all the processes involved in the enjoyment of the art piece.

Both the contexts cited in the last two contributions, clear doubts about the non-tangibility of digital objects. One of the main perplexities about collecting digital objects has been about the *intrinsic immateriality and how it can affect the value of an artwork*.

The simple answer is that immateriality does not affect the value of an artwork. However, non-materiality can affect the enjoyment process. One interesting contribution is about virtual reality and the experience that a digital artifact can generate compared to the visual experience of traditional tangible artwork.

In conclusion, blockchain technology does overcome the limits of digital artifacts, in a context where archiving is essential. The main contribution that all the implications suggested, is the table of properties reported in the previous chapter. With the overcoming of limits of digital artifacts, the answer to the last question of the document seems clear:

➤ *Can NFT create disruptive innovation in the art market?*

Defining disruptive innovation as the application of new technology in an already existing market, with a process that starts from simple applications at the root of a segment (Christensen, 1995), NFT can definitely create disruptive innovation in the art market. It is the opinion of some of the interviewed experts, in fact, that digital art will tower over the traditional art segment.

7.2 FUTURE RESEARCH

Due to the recency of the application, the lack of theoretical models and the pace with which technology advances, future research is needed to monitor the behavior of NFT.

First and foremost, a similar analysis will be needed in the future. The proposed analysis is limited by the width of the sample and by the recency of the application. Future scholars will have to monitor the evolution of the NFT market, to understand if it is in a bubble and what growth expectations can have. Moreover, said analysis will have implications for understanding the nature of the NFT innovation. Throughout this document it has been clear that NFT can create disruptive innovation, but will they create a disruptive innovation?

Second, blockchain technology and its size have to be monitored for the implications they have related to NFT. In a scenario where technology can no longer keep pace with Moore's law, the size of the ledger would probably be too extreme to operate fluidly. Moreover, the size of the network implies environmental problems, that we already endure, caused by the consumption of energy required to run the ledger.

Third, NFT are at the beginning of their path and the potential is, for now, unlimited. Future research will be needed in contexts different from the art segment. The technology has already been applied to tangible items, but the developments with digital objects are mainly related to collectibles. Scholars will have to analyze the evolution of technology in different digital environments.

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APPENDIX A

Interview text

My name is Stefano Reverberi and I am a student in Digital and Organizational Innovation at LUISS University in Rome. My master thesis' objective is to understand the application of blockchain technology and NFTs to the art world (and by this I mean both digital artworks and tangible "analog" artworks that are digitalized), to better understand if this technology can create disruption (innovative disruption) in different aspects of the art world – creation, selling, collecting, enjoying, managing, etc. – eventually creating a split with the more traditional art market, with new values, niches, products, methods.

The thesis is based on an interpretative approach and it will have in different interviews to experts (as artists, collectors, managers of platforms) its primary source to draw its conclusions.

Having identified you as an expert, I would like to ask you the following questions, while guaranteeing you anonymity, if it is necessary.

I thank you for your time and I would like to invite you to report to me if you are interested in the thesis' results, so I can send you a summary of them.

1) What was your first approach to art? What is your current process of interaction with art?

2) Why have you decided to enter the NFT's world?

3) What are the major differences, that you experienced, between creating, producing and selling digital artworks (both digital and digitalized products) that involve the use of blockchain technology, compared to analog art?

4) Which are the major features that differentiate digital art from analog art?

5) Benjamin states that artworks were not originally created for the mass, and only after the age of mechanical reproduction they became "for the mass". Do you think that being able to access artworks more easily can change the value of the artwork? And in which way?

6) *Scarcity is still an objective for artists? And if it is, is there a method to ensure or create scarcity? Can blockchain technology create a level of exclusivity that can contrast the ease of reproducing digital artworks? How does non-materiality affect the artwork in this process?*

7) *Has an ecosystem (as an interlinked network between different subjects) been created around digital art? If it has, how do platforms, forums, communities, affect the process of creating, producing and selling art? Did you observe differences between this type of environment related to digital art and the ones connected to analogic art?*

8) *Considering that digital art needs a device to be enjoyed, where is the difference between enjoying digital and analogic art? Is digital art an evolution of enjoying art or is it a new opportunity for the art world where digital art can take a different direction compared to the more "traditional" art? In which way?*

9) *What is the potential of digital art and the interaction between art and blockchain technology?*

SUMMARY

Background

In the last few months, a new application of blockchain technology has stormed the world of collectibles and valuables: NFT. Due to the recency of the innovation, its potential for radical changes is still unknown, but those who acted and adapted rapidly to this revolution are now in a privileged position where they can gain from their intuition.

NFT, or Non-Fungible Tokens, are a simple concept applied in a complex environment. For instance, they technically are online certificates (tokens) of authentication and uniqueness (non-fungible) that can guarantee the ownership of digital items.

The mechanism behind NFT is the Blockchain, a distributed online ledger that is immutable and integer by definition.

These first paragraphs do not justify academic relevancy to well-known technologies. However, even if NFT are technically the certificates just described, they have become synonyms, among communities, with a unique combination of digital assets: an item that falls into the realms of collectibles and art, connected to the underlying digital passport recorded on one blockchain. They are digital art with an immutable record of authenticity and ownership.

This peculiar combination implies a set of properties that are not intrinsic to digital artifacts. In fact, the very nature of digital artifacts, that cannot afford the plentitude of traditional media, prevents them to be archived (Kallinikos, Aaltonen, Marton; 2013)

To be more specific, digital artifacts are editable, reprogrammable, open, unstable, abundant and easily replicable (Kallinikos, Aaltonen, Marton; 2013. Yoo; 2010. Ekbia; 2009. Manovich; 2001. Mardon, Belk; 2018). All these properties highlight that it is extremely difficult, and in most cases impossible, to collect and archive digital artifact because they lack a mechanism that can guarantee authenticity and provenance (Kallinikos, Aaltonen, Marton; 2013. Benjamin; 1935).

In a context of non-materiality, in order to be collected, digital objects need a trusted ledger which certifies their authenticity.

In the outlined environment, blockchain's networks can solve the issue. In fact, blockchains are distributed, online, immutable, digital ledgers, or simply a list of records.

Blockchain-like models have been proposed since the '80s (David Chaum in 1982 proposed a structure that awarded him the title of inventor of digital cash), but the first-ever implementation has been Nakamoto's Bitcoin Blockchain in 2009, a year later their proposed system.

The blockchain is a sequence of blocks, which holds a complete list of transaction records like a conventional public ledger (Lee Kuo Chuen, 2015); the "blocks" that compose the chain are data packages where a single block contains multiple transactions.

Each block is connected to the previous block (with a sequence identified as "has of block $i-1$ " for every i block) and the chain is extended by each additional block on top of the *genesis* block (the first block of the chain, that connects to no previous block).

Hash values are unique and this concept ensures the integrity of the whole structure and prevents fraud. In fact, a change in a single block in the chain would change the unique value of its hashes.

Blockchain relies on its unique model that allows untrustworthy transactions to be made without involving a third party. A block can be added to the chain if the majority of the nodes in a network agree by a consensus mechanism.

According to Swanson (2015), this consensus mechanism "is the process in which a majority (or in some cases all) of network validators come to an agreement on the state of a ledger. It is a set of rules and procedures that allows maintaining a coherent set of facts between multiple participating nodes"

Once a block is registered by the ledger, the data and information that it contains, cannot be changed.

There are different types of blockchain's models, but they all share properties that are fundamental for the collecting issue.

To be more specific, blockchains are immutable, transparent and publicly verifiable. These two properties derive from the very nature of these ledgers, that are decentralized.

Immutability and transparency of the records ensure the solving of the two main issues connected to the archiving of digital artifacts. In fact, records of authenticity on the

blockchain cannot be altered (issue of authenticity) and every transaction involving a certain digital asset is recorded (issue of provenance, in space and in time).

Research purpose

Due to their recent implementation and popularity, academic literature lacks a model which describes Non-Fungible Tokens.

The purpose of this project is to understand NFT properties and trace a structure that can be academically relevant and a reliable contribution when describing these digital assets.

The main research question underlies in the possible contradiction that involves properties of blockchain and digital assets:

- *Can blockchain technology overcome the limits and challenges of digital artifacts?*

The question is inserted in the context of collecting art. To draw a reliable model, NFT are compared, throughout the document, with traditional art. We know from Kallinikos, Aaltonen, Marton (2013), in fact, that digital objects lack the plentitude and stability afforded by traditional media.

In this comparison, more implicit research questions, mainly about immateriality and scarcity, will emerge throughout the document.

All the implied questions help to pave the structure for NFT and identify their main properties that, outlined in the document, will finally answer the question:

- *Can NFT create disruptive innovation in the art market?*

Research design

The project's purpose is not to verify existing theory models, but to understand from the inside what made NFT so popular in the last months and if their popularity is just a spike in an otherwise flat graphic or if the technology can evolve to the point where we no longer talk about digital art in reference to traditional art.

Hence, the discussion is based on an approach that is defined as qualitative and interpretative and the model used is categorized as a qualitative investigation.

The research is based on a comparative structure between the different empirical findings reported, to understand where a generalization of answers can be outlined to have academic relevancy.

The recency of the phenomenon and the lack of previous theoretical structure both imply that qualitative data has to be collected from insiders. Moreover, the research questions aim to understand perspectives that can be observed from inside only.

The logical research method is, then, to collect answers and opinions from experts with the help of semi-structured interviews.

In light of the NFT market's model, which identifies the two actors involved in an exchange in artists (sellers) and collectors (buyers), the interviewees' profiles were easily determined.

As mentioned before, the issues in archiving digital artifacts can be primarily correlated to the non-materiality of digital objects and the absence of a state of scarcity. These problems, combined with the two main research questions, outlined the interview draft and what was crucial to understand from insiders.

The interview is composed of 9 open semi-structured questions, to trace the borders of the topic, but let the interviewees feel free to answer in their personal manner.

The interview's questions can be categorized into sections.

For instance, questions 1 and 2 explore the choices of entering the NFT world. Answers to questions 3 and 4 outline the main differences between digital art and traditional media. Questions 5 and 6 are about the ease of reproduction and scarcity. Question 7 is about the ecosystem around the NFT community. Question 8 asks about the immateriality of digital collectibles. Question 9, with no academic purpose, asks interviewees their opinion about the future of NFT.

All the contributions collected with the interviews have been analyzed, integrated with secondary data, compared to theoretical models and completed with critical thinking and personal contributions. The conclusive part of the project shows that empirical findings have been crucial to answer the main research questions.

Findings and Conclusions

To better understand the results of the project, findings and insights were compared to the main research purpose and the underlying research questions.

The intent of this project was to answer the question:

- *Can blockchain technology overcome the limits and challenges of digital artifacts?*

The simple answer to the main research question is: yes, blockchain technology can (and do) overcome the limits of digital artifacts.

In detail, the main problem outlined in the theoretical framework is about archiving digital assets. NFT, as digital immutable certificates of ownership, allow digital assets to be archived, stored and collected.

In fact, provenance and traceability are properties intrinsic to NFT. Combined with the immutability of data, these new assets allowed the proliferation of a market that can be compared to the traditional art market.

Blockchain's technology is so effective in resolving the issues about collecting, that most of the collectors in the market entered with an intent of profit rather than aesthetic. This conclusion can be drawn from answers to question 2.

The acquired possibility of authentication for digital objects, partially clear doubts about a *comparison between cryptoart and traditional art*. However, the two markets are not perfectly comparable in every aspect and contributions throughout the document highlighted *advantages, disadvantages and differences between analog art and the NFT segment*.

For instance, artists and collectors both noted that in terms of participation, accessibility, and community, the NFT market is a better choice compared to the traditional market, where gatekeeping is a diffuse practice and the entry barriers are usually high.

In the context of archiving, all the profiles agreed that NFT provide a level of trust more than sufficient to collect. This property, intrinsic of the blockchain, contrasts some properties intrinsic of digital artifacts, in particular the lack of an authenticity certificate.

This last paragraph clears any doubt about the *state of scarcity in the NFT market*. In fact, in the document, the main implicit doubt has always been:

➤ *Can blockchain technology create a reliable state of scarcity?*

The short answer is yes. The technology behind distributed decentralized ledgers is immutable and incorruptible, thus ensuring a level of scarcity in the segment that is more than sufficient. NFT are unique and cannot be falsified. This belief is also reinforced from the already mentioned answers to question number 2, where collectors explain their goal of profit. If blockchain could not ensure a level of rarity compared to the traditional art market, and for instance to every market where scarcity is important and drives the value of an item, there would be no sense in collecting cryptoart to earn by reselling it.

In terms of creation, artists noted that digital art is more easily accessible, less expensive and can cut time in some actions within the production process.

In the context of selling, buying and showcasing, all profiles agreed that non-materiality provides artworks with the property of ubiquity, facilitating all the processes involved in the enjoyment of the art piece.

Both these contexts, clear doubts about the non-tangibility of digital objects. One of the main perplexities about collecting digital objects has been about their *intrinsic immateriality and how it can affect the value of an artwork*.

The simple answer is that immateriality does not affect the value of an artwork. However, non-materiality can affect the enjoyment process. One interesting contribution is about virtual reality and the experience that a digital artifact can generate compared to the visual experience of traditional tangible artwork.

Another interesting opinion about immateriality is tied to the related property of ubiquity. For collectors, the ability to access artworks online drastically reduce the gatekeeping barriers of traditional art. Immateriality drives the concept of exhibition value, proposed by Benjamin in his essay, to the extreme; however, as stated by the German critic in 1935 and by artists and collectors, accessibility have positive reflections in expanding the community.

In conclusion, blockchain technology does overcome the limits of digital artifacts, in a context where archiving is essential. With the overcoming of limits of digital artifacts, the answer to the last question of the document seems clear:

- *Can NFT create disruptive innovation in the art market?*

Defining disruptive innovation as the application of new technology in an already existing market, with a process that starts from simple applications at the root of a segment (Christensen, 1995), NFT can definitely create disruptive innovation in the art market.

To conclude, a taxonomy about properties of NFT, which is drawn from theoretical implications of digital artifacts and blockchain technology, in addition to experts' answers, is proposed.

NFT are

- **Immutable and incorruptible:** once an NFT code is registered on the blockchain and confirmed by other peers, the information cannot be changed (Lamport, 1982; Nakamoto, 2008).
- **Authentic:** thanks to the level of trust provided by blockchain technology.
- **Unique:** it is intrinsic in blockchain's nature that every data recorded on the network is unique and different compared to other data. This applies to every item recorded on the blockchain too.
- **Traceable and transparent:** in space and in time. Every transaction recorded on the blockchain is immutable, transparent and integer (Zheng, Xie, Dai, 2018).
- **Unreproducible and scarce:** every asset record on the blockchain cannot be reproduced.
- **Immaterial:** NFT are, in fact, not composed of matter.
- **Transferable:** being digital objects and linked to the blockchain, NFT are online.
- **Self-referent** they require digital technology to be operated, created, produced, stored, modified, etc. (Yoo, Henfridsson, Lyytinen, 2010).
- **Communicable and senseable:** because of their properties of interactivity (Yoo; 2010) and automation (Manovich; 2001)
- **Memorable and associable:** they store data for every transaction in which they were ever involved. These properties are complemented by traceability (Yoo, 2010)
- **Granular:** in reference to the minute size of their components.

