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From Physical to Digital: How Non-Fungible Tokens enable brands to legitimate products' value in the counterfeit fight.

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October, 2022

BUSINESS
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Business School

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Resumo

Desde o surgimento do comércio, as marcas têm partilhado quota do mercado com as suas falsificações. Os elementos físicos que determinam uma marca no mercado, como nome, cores, e inclusive atributos mais inerentes, como a qualidade e o desenho, têm sido deliberadamente subtraídos e copiados. Na medida que os processos de manufatura melhoram, para criar produtos melhores e de melhor qualidade, igualmente a facilidade e qualidade das falsificações melhora, criando maior confusão no consumidor no relacionado à autenticidade dos artigos. Como o conflito contra as falsificações é tão antigo como o comércio, diferentes estratégias têm sido utilizadas para enfrentar o problema, e até a data nenhuma tem concluído a luta. Embora as soluções baseadas em Blockchain para combater as falsificações estejam ainda numa etapa muito prematura, o objetivo deste estudo é investigar os efeitos na perceção de valor e as intenções de compra dos produtos certificados pela aplicação do Blockchain chamada Non-Fungible Tokens (NFT). Através da aplicação da Teoria do Comportamento Planeado foi possível explorar as oportunidades de aplicar esta nova tecnologia no combate às falsificações. Os resultados mostram que as atitudes e as crenças comportamentais podem levar à aceitação dos NFT, no entanto a opinião dos outros tem um papel fundamental na intenção de compra. Enquanto as marcas se estão a adaptar ao novo modelo digital e o retalho começa a explorar integrações no mundo digital, o presente estudo mostra o potencial das novas soluções digitais.

Palavras-chave: *Falsificações; Marca; Autenticidade; Certificado; Blockchain; Non-Fungible Tokens*

JEL: M30 – General, M31 – Marketing, L81 – Retail and Wholesale Trade

Abstract

Since commerce has existed, brands have shared a quota of the market with their counterfeits. Physical elements that differentiate brands in the marketplace, such as name, shape, color, and even more intrinsic attributes like quality and design, have been deliberately stolen, seized, and copied. As manufacturing processes advance to create better quality products, so does the quality and ease of counterfeiting, making consumer question its authenticity. Within the last developments in cryptography and encryption, Blockchain solutions have been used to tackle counterfeits. However, they are still in early adoption. Therefore, the aim of this study was to investigate the effects on the value's perception, and the buying intention of products endorsed by a Blockchain application defined as Non-Fungible Tokens (NFT). The Theory of Planed Behavior was used to explain the intentions and assess the opportunity of implementing this new technology in the counterfeit fight. The results show that attitudes and behavioral Beliefs can lead to the acceptance of NFTs. However, the opinion of others plays the most determining factor in the buying intention. As brands make a shift to digital content and retail starts its path towards digital integration, the present study shows the potential of new digital solutions within physical applications.

Key words: *Counterfeit; Brand; Product Authenticity; Certification; Blockchain; Non-Fungible Tokens*

JEL: M30 – General, M31 – Marketing, L81 – Retail and Wholesale Trade

TABLE OF CONTENTS

TABLES

FIGURES

1. Introduction

Since the conception of commerce and trading, brands started to emerge. At its roots, branding was the basic marketing resource that allowed sellers to stimulate the demand for their goods and services. A branded product gave a distinct identity to it, in order to be shown in the market to potential customers, and differentiate one seller from another (Andrew, 2011). Parallel to the birth of brands, counterfeits were conceived. They adopted multiple forms and varieties, borrowing the identity of a brand for the commercialization of goods without the original brand consent (Cordell, 1996). This unwanted coexistence of originals and counterfeits led to a never-ending fight aimed to eradicate counterfeiting. Laws, protections, and expensive measures have been implemented, and still, none of them seems to affect the counterfeit phenomenon (Lybecker, 2008).

According to the latest publications, as of 2020, the annual sales losses derived from counterfeiting were 46.6 billion euros, clothing being the most affected industry with 26.3 billion euros of losses, followed by the pharmaceutical industry with 10.2 billion euros, cosmetics & personal care 4.7 billion euros, and watches & jewelry with 1.9 billion euros (Statista, 2022). Further statistics also mark counterfeit products (pharmaceutical and electronics) as the illegal goods with the highest sales worldwide. The report published in 2020 by Statista highlights both segments with a total of 300 billion USD as of 2018, leading the chart of illegal products that goes from small arms to prostitution (Statista, 2018). These previous statistics emphasize the impact that the counterfeit fight has made on each industry, how despite all the implemented strategies and laws deployed to protect brands and consumers, to the date, counterfeit has just expanded and threatened more segments, and confused more consumers.

Counterfeit can be categorized into two variants: non-Deceptive counterfeit, where the buyer is completely aware of its unauthorized mimic of the brand, and Deceptive counterfeiting, where buyers are unaware of the fraudulent origin of the product (Bachmann et al., 2019). It is in this second variant of counterfeiting where brands have tested countless strategies to eradicate the counterfeits. Pharmaceutical companies, backed up by the World Health Organization (WHO), fight the threat of unauthorized counterfeited drugs endangering lives in the same degree of threat of the most dangerous illnesses (Lybecker, 2008). Luxury products, electronics, food, textiles, footwear, and almost all industries expending billions in numerous

devices and strategies to fight counterfeiters (Zhiwen et al., 2021). However, despite all previous attempts, the fight against counterfeits is far from being over. All previous measures and budgets burned to strike it have not managed to surpass the increasing counterfeit's ability to mimic and deceive customers (Pun et al., 2021).

In this struggle against counterfeits, a new technology arises. Blockchain and, within its technology a new form of digital commodity called Non-Fungible Tokens (NFTs), show a possible definitive solution to effectively prevent counterfeiting by creating a reliable way of certification for all kinds of products (Butcher, 2018; Griffin, 2018). The goal of this thesis is to explore the evolution of the counterfeits in the markets, why the previous measures and strategies aimed to stop it have not worked, and what new advantages are brought to the table by the implementation of NFTs in the fight against deceptive counterfeiting.

An initial approach to the possibility of using NFTs inside the industry has been already studied. Companies are implementing Blockchain solutions within the supply chain to record every step in the chain, and thus guarantee a solid record of the product's fabrication process (Butcher, 2018). Other approaches show how digital art and NFT evolved into a new market and created a new concept of digital property (Trautman, 2021). The last example of the academic background for Blockchain applications comes from a publication about Crypto-Art, explored as a better solution for preserving art value over time versus the traditional physical essence of art (Valera et al., 2021).

Previously mentioned studies open the door for the possible applications of Blockchain technology in different scenarios. They allow us to understand the adaptability of this technology to diverse fields, and they explain how some industries are already adapting it to their own needs. Nevertheless, these previous approaches focus mainly on the characteristics that can be transmitted from a physical product to a digital one, such as a visual artwork becoming a digital art (Trautman, 2021). In these approaches, the physical product goes to a second plane, or transmutes completely to digital. There is, therefore, still the opportunity to study a more symbiotic relationship between physical and digital, where the physical product and the digital equivalent complement each other, and seize their features, to create value and seek solutions for existing problems inherent of the physical nature, mainly counterfeiting.

The objective of this study is to develop an understanding of current problems faced by brands in the advent of the digital era and the fight against counterfeits. Blockchain application may be an excellent solution to issues like copyrights, illegal copy and sharing, deceiving counterfeit consumption and other topics that remained unsolved, as previous technologies did not offer the capacity necessary to confront them in an efficient and effective way (Pun et al., 2021). To do so, the Theory of Planned Behavior proposed by Ajzen (Ajzen, 1991) is used as a method to explain the purchase intention of products certificated by Blockchain in the shape of NFTs, and its impact on the value perception of authentic products. With this objective in mind, the following questions are the focus of the study:

A) What is the consumer's purchasing intention for NFT-certificated products and the psychosocial antecedents of these intentions in the fight against deceptive counterfeit?
B) How do the Beliefs, Subjective Norms, and Perceived Behavioral Control (PCB) influence the Intention to purchase NFT-certificated products?

This study does not aim to fully explain the technical aspects, neither to give deep understanding of the Blockchain technology. However, the second section of this document is dedicated to explaining the basics of Blockchain, how it was conceived, and how it allowed to create NFTs. This aims to inform how a digital certification works, without the need of a deep technical knowledge, as the general idea of a Blockchain structure is explained, focusing on the characteristics that made it ideal to tackle situations like legitimacy and counterfeit consumption.

2. Literature Review

2.1. Counterfeit Consumption

2.1.1. The "Second oldest profession"

Counterfeit production and consumption are problems as antique as the commerce itself. Brands have co-existed with their counterfeits in all the sectors of the economy, to the point of even being address as "the second oldest profession" which can be tracked to the fourth century BC

(Lybecker, 2008). Governments, companies, and international organizations have fought against counterfeiting in all possible scenarios, and, since early 2000's, brands have committed to eradicate it. This has only created enormous budgets aimed to anticounterfeiting measures, laws and politic agendas which, far from ending the issue, have just seen it grow and expand into more sectors, leveraged by globalization (Jähnke, 2004; World Health Organization, 1999).

Counterfeit consumption has been studied since early 1970s and its definition has evolved over the years as the characteristics taken from the original product advanced from the physical counterfeit of a product to more complex levels of counterfeiting. Numerous authors have developed definitions for the term, relying on the type of products and level of counterfeit. The **Table 1** shows the various definitions and the evolution of the term counterfeit within the academic's publications by previous authors.

Author(s)	Definition
Cordell, 1996, p. 41	*"Any unauthorized manufacturing of goods whose special characteristics are protected as intellectual property (IP) rights, or trademarks, patents, and copyrights".*
Jacobs et al., 2001, p. 501	*"Unauthorized production of goods protected by trademarks, copyrights, or patents".*
Sonmez & Yang, 2005, p. 6	*"Producing the same products by imitating the designs, colours and badges from the original products and marks".*
Chaudhry et al., 2009, p. 59	*"Unauthorized manufacturing of goods whose special characteristics are protected as IP rights, or trademarks, patents, and copyrights".*
Spink et al., 2013, p. 8	*"All aspects of the fraudulent product and package are fully replicated".*
Evans et al., 2019, p. 709	*"The appropriation of the exact IP (including brand name, logo, colour, and product design) of the copied brand".*

Table 1 Counterfeit definitions in chronological order

2.1.2. Degrees of Counterfeiting

Studies dating from 2005 (Chaudhry et al., 2009; Evans et al., 2019; Sonmez & Yang, 2005; Spink et al., 2013) converge in the acknowledgment that counterfeits imitate all relevant intellectual property (IP) elements: name, logo, trademark, color, packaging and labels. Other kinds of copies or fakes were described by the multiple studies develop by Spink (Spink, 2009b, Spink, 2007, Spink, 2013) ranking from adulteration of a legitim product to the total counterfeit of it. All those previous works have reinforced the importance of proper legal protections and

how brands must have a clear anti-counterfeit strategy, but they have also acknowledged the complexity of the threat and its evolution in the markets. The **Table 2** explains the different levels of counterfeiting.

Term	Definition
Adulterate	*"A component of the legitimate finished product is fraudulent"*
Tamper	*"Legitimate product and package are used in a fraudulent way"*
Over-run	*"Legitimate product is made in excess of production agreements"*
Theft	*"Legitimate product is stolen and passed off as legitimately procured"*
Diversion	*"The sale or distribution of legitimate product outside of intended markets"*
Simulation	*"Illegitimate product is designed to look like but not exactly copy the legitimate product"*
Counterfeit	*"All aspects of the fraudulent product and package are fully replicated"*

Table 2 Degrees/kinds of counterfeits
Reproduced from (Spink et al., 2013)

One industry in particular has a long story of counterfeit problems and struggles. In 1985, the World Health Organization (WHO) declared its position regarding counterfeits in the pharmaceutical industry. For the WHO, counterfeit products represented a threat at the same degree of illnesses like AIDS or malaria (Lybecker, 2008). The main problem did not come from the imitation of the products or the loss of sales and incomes, which was the first impact; it was also not just specific to the pharmaceutical companies, where the health and in cases life of consumers are compromised. The problem was that the reputation of the brands is in play (Knox, 2003).

The economic impact for brands linked to counterfeit products is far from an easy calculation. Normally, its trade is catalogued as illegal and data about those transactions are hard and complex to obtain and be analyzed. However, the Organization for Economic Co-operation and Development (OECD) published in 2016 an estimative of $46 billion USD, meaning that an approximative 2.5% of the world trade are the estimated economical losses for brands (Plane & Chen, 2020).

Over the years the markets affected by counterfeiting have evolved. In the past, premium or luxury products were the main target for counterfeiters, as well as high end electronics, apparel and accessories. As the markets develop, the international trade opens to a new range

of products. Nowadays, daily consumption products, toys, food and other are also on the list of affected industries (Chapa et al., 2006). Another component adds complexity for the brands and the consumers to this increased number of markets affected. The difficulty of effectively detecting a counterfeit from an original product has increased to a point where, in certain situations, counterfeits cannot be detected even within the supply chain (Shepard, 2017).

With the retail industry moving towards the online integration, counterfeit products found a new ground for their development. The previous challenges that customers faced to detect them in physical channels were now added to digital marketplaces where a close inspection of the good before the transaction is not possible. This new model based on the global distribution of goods and counterfeits greatly strengthens their presence (Robertson et al., 2012).

2.1.3. Counterfeits Consumption Categorization

Previous literature has categorized the consumption of counterfeits into two different types of purchases, each one having its own extensive academic research and with completely opposite foundations(Viot et al., 2014). First, the Non-Deceptive counterfeits address the acknowledged and deliberated decision of purchasing a counterfeit product (Baghi et al., 2016). The second category, described as the Deceptive counterfeit, where the act of purchasing is a misguided selection of a product with the strong belief of its originality, followed by the eventual discovery of its counterfeit origin (Bachmann et al., 2019; Viot et al., 2014). This thesis mainly focuses on the second type of purchase, the Deceptive counterfeit consumption as a non-deliberate choice, supporting the idea that the most significant challenge for brands these days is how to avoid consumption of counterfeits driving consumers on both channels (offline and online), leading to the loss of confidence and driving the users to decrease the brand experience (Boukis, 2020).

2.1.4. The Counterfeit Fight

Counterfeit products benefit from the physical attributes and brand elements that are easily replicated, such as name, shape, symbol, color, designs, badges, and packaging. These attributes of a product mean no challenge for a manufacturing process to be stolen (Zaichkowsky, 2020). However, other scholars have found that products and brands possess other inherent values that

cannot be copied, such as heritage, artistic design and craftmanship (Kapferer & Michaut, 2014). The first brand elements protected by laws and copyrights find those measures insufficient, as online markets, by nature, make it more difficult to control the supply chain, and customers lack the proper environment to evaluate the physical product before closing the transaction. The second range of brand attributes has not found until today a proper approach to materialize and endorse the intangible characteristics that would make product impossible to fake (Boukis, 2020).

Most industries, such as clothing, footwear, cosmetics, handbags, and watches, have been involved in the fight against counterfeiting, accounting for an estimated $323 billion USD in losses worldwide just in the online market and projecting a total of $1.8 trillion USD by the end of 2020 (Zhiwen et al., 2021). Until now, a wide array of measures have been tested to prevent counterfeiting. Among the main strategies, we can find the following. Radio frequency Identification (RFID), which are tiny radio transmitters embedded into a label or a piece of a product that, when scanned, transmit the data about the product, therefore identifying the good as original and tracking its inventory (Scott, 2014). Holograms are made by generating three-dimensional images, which will display a different image when seen from different angles. They require specialized and technologically advanced equipment to reproduce and are used to tag goods to identify them as genuine (Gianluca et al., 2017). Quick Response (QR) code or two-dimensional barcodes are labels that can be read by machines and contain information about the item to which they are attached, helping brands, retailers, and distributors to verify the originality of the items (Baldini et al., 2015).

Yet those solutions share two mayor flaws that ultimately drove them ineffective in the fight with counterfeit. First, it is still possible for the counterfeit manufacturer to replicate the information transmitted by RFIDs, holograms or QR codes. Second, after the products are purchased all tags and authenticity certificates are remove, not granting the secondhand market any verification method (Pun et al., 2021). As a result of all these failed attempts to stop counterfeiting, consumers have stopped believing the information on certificates, tags, and other methods, knowing that it can be manipulated and that it does not grant a complete proof of authenticity (Cho et al., 2015).

Parallel to this fight emerged a new technology called Blockchain (Nakamoto, 2008), and it provides a possible new solution for the counterfeit fight. Essentially, Blockchain technology is an append-only distributed ledger where each transaction is recorded on a block and linked

to the previous block, containing not just all the previous information until the date but also a unique identificatory ("hash value"), which makes the ledger highly resistant to modifications (Nakamoto, 2008; Zhiwen et al., 2021). The characteristic of the Blockchain technology has drawn the attention of big companies trying to improve product transparency and traceability of food supply chains (Slocum, 2017). It enabled the companies to record important data, such as collecting dates, storage temperatures, expiration dates, origin details, lot numbers, among other relevant information about the products being sold, creating permanent records on the Blockchain that consumers could easily retrieve and consult by scanning the products (Choi et al., 2019).

2.1.5. Blockchain Structure and the Creation of Digital Value

More than a decade ago, close to the end of the year 2008, an anonymous group identified by the pseudonym of Satoshi Nakamoto published the article "Bitcoin: A Peer-to-Peer Electronic Cash System". Within these pages, the concept of electronic cash was proposed, supported by the concepts of Peer-to-Peer (P2P) networks, cryptography encryption and timestamps (Nakamoto, 2008). This new concept brought to life the Blockchain implementation of the Bitcoin (BTC). Ethereum (ETH) would be conceived 7 years later by Vitalik Buterin, who used a similar approach to digital currency but with the capability of supporting the development and implementation of other applications and executing more complex functions than BTC, such as smart contracts (Liu et al., 2021).

To understand Blockchain technology in a less technical context (as it is not the main aim of this study), it can be explained as a system constituted by layers (Liu et al., 2021). Although not all Blockchain applications follow the same rules, the following 6 layers constitute the architecture of most systems: data, network, consensus, incentive, contract, and application **(Fig. 1)**.

I. Data: It has the responsibility of storing the information, recording all transactions, and assigning a timestamp to each one of them, holding the encryption data and carrying the hash value that will chain each block with the previous one.
II. Network: It contains the links to the other nodes in the system, essentially other users as the P2P nature of the Blockchain, and it carries the protocols needed for them to interact and verify the exchanged information.

III. Consensus: It guarantees the integrity of the shared information by reaching all the nodes in the system and by making them agree on the veracity of the stored data. Several consensus algorithms exist, such as: Proof of Work (PoW) (Nakamoto, 2008), Proof of Stake (PoS) (Buterin & Vitalik, 2014), and Practical Byzantine Fault Tolerance (PBFT) (Cachin et al., 2017).

IV. Incentive: It establishes the rules for the incentives given to every node that actively participate in the consensus process, encouraging the participation in the verification of the stored data.

V. Contract: It stores the contracts or algorithms that will be executed when the set of conditions are met, creating an automated execution of the contract commands. When needed, a smart contract can interact with the world outside the blockchain, i.e. with off-chain external data sources, known as oracles (Al-Breiki et al., 2020), enabling to customize certain contract specificities.

VI. Application: It is the layer aimed to the users. In the Bitcoin case, it means the cryptocurrency that supports transactions and payments or, for the development of this study, the NFT.

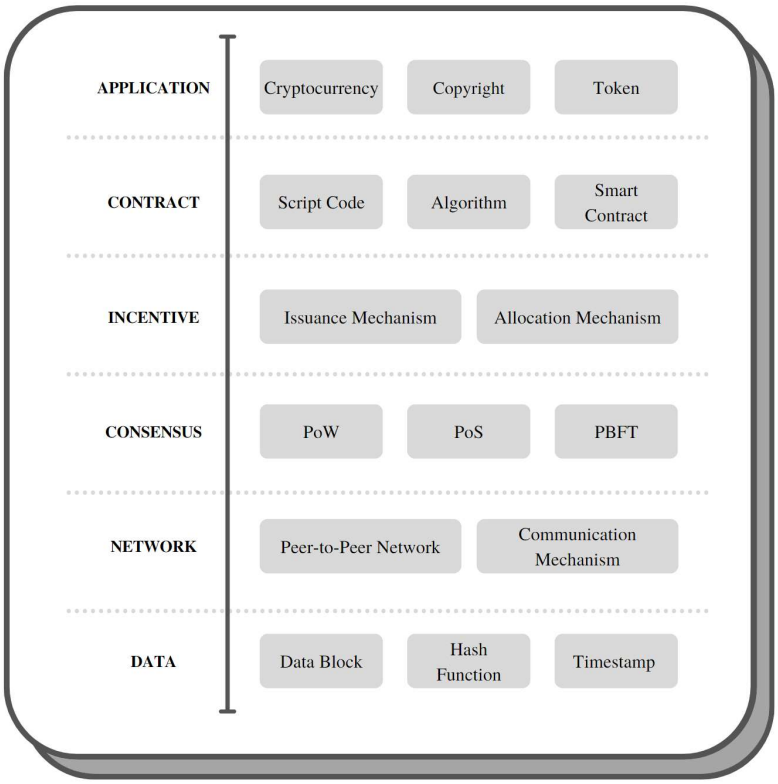

Figure 1 Generic layers structure of a Blockchain

Once a transaction is executed in the Blockchain, it is irreversible. This makes the ledger a permanent record of past transactions, because when the new transaction is appended, it is considered completed (Boukis, 2020). This will follow 6 steps (**Fig. 2**), which will integrate the previous block of information with the new one, and it will make use of the previously mentioned layers of a Blockchain during the process.

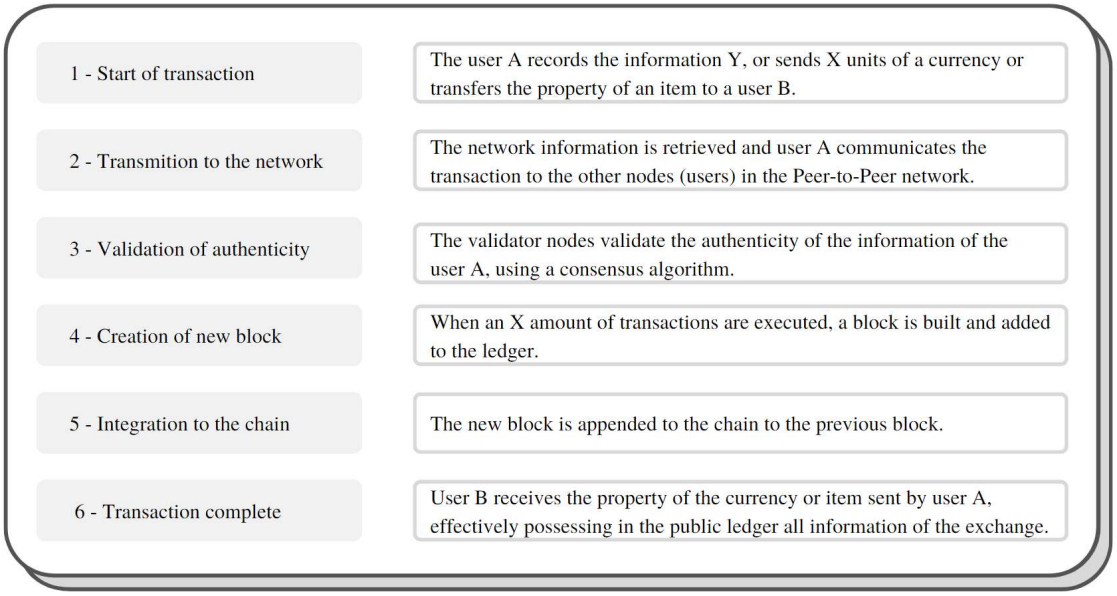

Figure 2 Steps of a Blockchain transaction

Due to Blockchain's nature, 4 main factors are highlighted when exploring the possible advantages that its applications could bring to the brand-customer relationship. These contributed the most to the different problems faced by brands in their struggle with issues like copyrights, illegal copy and sharing, and counterfeit consumption.

I. It is a **distributed** Peer-to-Peer system, making each peer in the chain able to communicate and interact with another peer without the need of a third party or intermediary (Cui et al., 2017).
II. All transaction records are public and visible in a shared ledger. This **transparency** attribute gives a positive value in trust building, as every participant is ensured that the information cannot be corrupted(Boukis, 2020).

III. It is a **cryptographic** chain of blocks of data where each node keeps a copy of the history of all transactions and a complex mathematical equation validates the transactions' legitimate origin (Lin & Liao, 2017).

IV. The identity of all peers in the network is completely **anonymous** as the cryptography mechanism never discloses identities and no third parties that could store those details are involved (Kus Khalilov & Levi, 2018).

These 4 factors together brought to the market a relatively new concept. The problems underlying the digital assets, where copyright, provenance assurance and tracking were nearly impossible, seem to be solved and a flow of digital value through the Blockchain, which received the name 'The Internet of Value', was developed (Gayvoronskaya & Meinel, 2020; Liu et al., 2021).

As a wide range of industries are facing today unprecedented concerns, such as, distribution of false information, illegal copy, sharing and distribution of copyright protected media (Boukis, 2020; Gleim & Stevens, 2021; Khezr & Mohan, 2021; Liu et al., 2021), most of these problems may be tackled by their potential Blockchain implementation.

2.1.6. Physical Products and Digital Certificates

From the marketing perspective, the idea of a customer having the ability to scan a product, enter to a platform, consult the recorded information about the products, and interacting with the brand with the assurance of transparency and trust, two of the benefits of Blockchain, brings them closer to create a long-term relationship (Treiblmaier, 2021). In the luxury industry, smartwatches brands like the Russian Petrodvorets Watch Factory (PWF) and the Swiss company Vacheron Constantin (VC) started recording on the Blockchain the information regarding their watches when a customer buys a watch. At the same time, the digital certification of the specific watch acquired is transferred to him. This Blockchain record completely replaced the previous method of paper certificates for jewels and watches (Campbell Rebecca, 2016; Kolesnikov-Jessop, 2019).

This new approach addressed the two main flaws of previous implemented strategies. First, RFID and other similar technologies were easy to replicate and fake by the counterfeits manufacturers (Pun et al., 2021); on the other hand, Blockchain is immutable and cannot be

copied (Nakamoto, 2008). Second, the tags removed from a product after its purchase leave the secondhand market lacking any authenticity check mechanism (Pun et al., 2021), while the Blockchain record will not disappear, as every new record also holds all previous records created, allowing the secondhand market to effectively validate the authenticity of a product even when bought from a seller not affiliated or endorsed by the company or from any previous owner (Pun et al., 2021).

This approach of the Blockchain technology was developed by the implementation of NFTs. NTFs are heterogeneous units of commodities that cannot be exchanged with other units of the same, since each one can be differentiated, and each one can be transferable (Treiblmaier, 2021). Under this approach, NFTs take the shape of certificates, which have been highlighted by The Boston Consulting Group for their ability to "*immutably track and share genealogy across multiple stakeholders, can inhibit counterfeiting in ways that traditional technologies cannot."* (Bhatia et al., 2019).

2.2. From Physical to Digital: Non-Fungible Tokens (NFTs)

With the creation of Blockchain and the development of the ETH environment (Buterin & Vitalik, 2014), new applications and uses started to be created and deployed. Apart from the more know cryptocurrency use of Blockchain, the ability of software codes to be executed and validated by the nodes in the network, also known as Smart Contracts, created the window for NFT to arise (Sillaber, 2017).

NFT can be explained as a unit of a commodity that cannot be exchanged with other units of the same commodity, while with a fungible commodity two parties can exchange the same number of units without any losses or gains (**Fig. 3**). For illustration purposes, €1 can be swapped with another person for another €1, as it is a fungible commodity, but this transaction could not be executed with non-fungibles, as every token is distinguishable and cannot be divided or merged (Voshmgir, 2020).

As explored by previous studies, a strong argument regarding the value of these digital items can be made as their value is, in theory, only attached to the context of the ecosystem where they belong (Regner et al., 2019), but NFTs could facilitate the tokenization of real-world items. Over the last years, multiple applications of this use have been explored.

Companies like Proxeus offer a range of uses in solutions to legal, education, sports, logistics and data storage problems, supported by the tokenization of real-world items, documents or workflows into the Blockchain (Griffin, 2018).

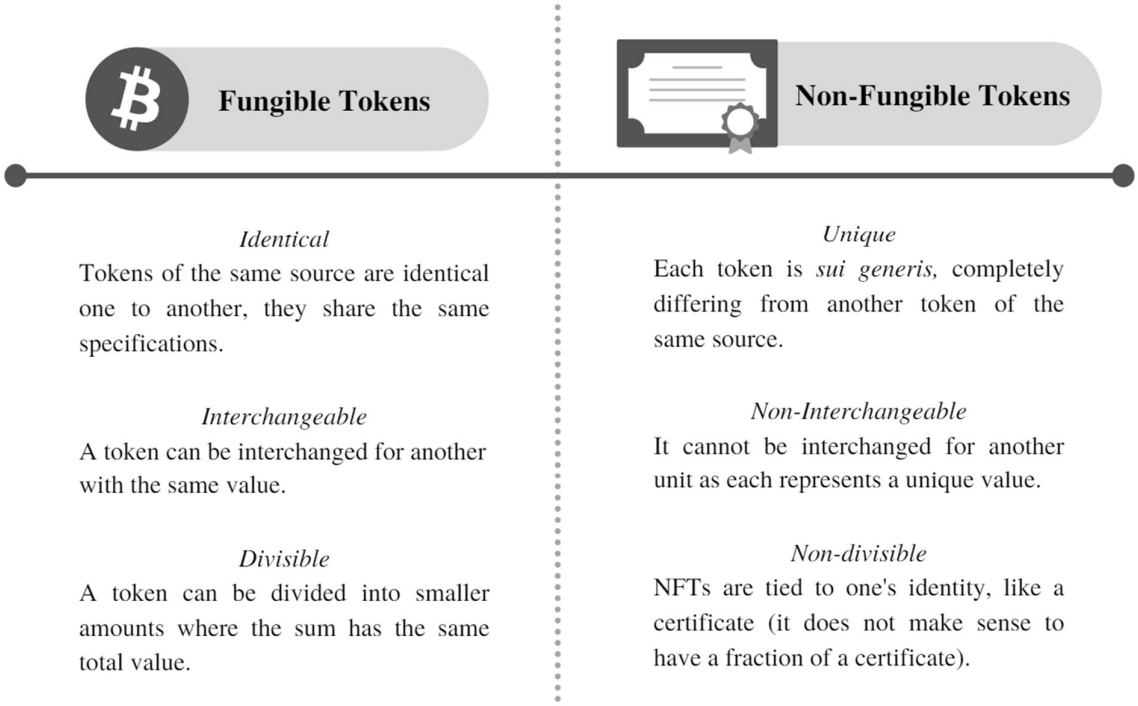

Figure 3 Fungible vs Non-Fungible

2.3. NFT Applications Against Counterfeit

When NFTs started to be explored as an effective measure against counterfeits, brands like General Motors, Ford or BMW, among other 30 car producers, joined efforts towards the implementation of Blockchain applications in a shape of NFTSs in the automobile industry (Butcher, 2018). Integrating digital NFT and physical good, a new service was created working as the Blockchain registration of the ownership and characteristics of classic and exotic cars, giving the owner a digital certificate in the form of an NFT, whose information will be safeguarded forever without alterations in the Blockchain.

The benefits of this approach for products' certification could drastically improve the interaction between brands and customers. First, from a transparency perspective, the NFT endorsing the product will store all traceability information from its fabrication to its current

owner, reduce possibility of frauds or fake information being altered in the Blockchain (Kshetri, 2018). Since products will be backed up by their companion NFT, customers will always be protected against all kinds of fraudulent products. As it is nearly impossible to fake information into the Blockchain, only the original products will be supported, rendering it impossible to accidentally consume counterfeit products, which deteriorates the interaction among brand and customer (Evans et al., 2019). Supported by the previous advantages of the NFT usage for the authentication of products, brands, can directly reach consumers at the online marketplace, eliminating the intermediaries as the validation of all transactions is conducted in the Blockchain. Thus, it would be possible to create a new direct environment of interactions, where new markets and regions, previously inaccessible due to logistics, intermediary costs, quality, or other reasons, could be reached directly (Vasarhelyi, 2017).

3. Theoretical Foundation

Acceptance of new technological advances has also been studied. While facing advances in technology and developments in processes, it was stablished that even when significant performance gains are proven to be achieved, most users are unwilling to use the innovative technology (Davis et al., 1989). The reasons people accept and adopt technological advances have been explored with the help of multiple models, from the Theory of Reasoned Action (TRA) (Fishbein & Icek, 1975) to the Decomposed Theory of Planned Behavior (DTPB) (Taylor & Todd, 1995).

While each model was adapted for the specific context of the study involved, the TRA (Ajzen & Fishbein, 1980; Fishbein & Icek, 1975) and the Theory of Planned Behavior (TPB) (Ajzen, 1991) are social psychology theories that aim to predict human behavior. Both can be adapted to multiple scenarios and they are proven to measure behavior. The Technology Acceptance Model (TAM) (Davis et al., 1989) was derived from the adaptation of the TRA to highlight Beliefs in a more technical scenario, and finally the DTPB (Taylor & Todd, 1995) was built on TAM and TPB (Ajzen, 1991), to have a deeper explanatory outcome of acceptance, behavior, and intention. The **Table 3** illustrates the models used in the academic field to explain behavior and acceptance by users/consumers.

Models	Constructs
Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Icek, 1975)	*Behavior* *Behavioral Intention* *Attitude Toward Using* *Subjective Norm* *Behavioral Beliefs* *Outcome Evaluations* *Normative Beliefs* *Motivation to Comply*
Theory of Planed Behaviour (Ajzen, 1991)	*Behavior* *Behavioral Intention* *Attitudes* *Subjective Norm* *Perceived Behavioral Control* *Beliefs*
Technology Acceptance Model (Davis et al., 1989)	*Behavior* *Behavioral Intention* *Attitude Toward Using* *Perceived Usefulness* *Perceived Ease of Use*
Innovation Diffusion Theory (Moore & Benbasat, 1989)	*Adoption Decision* *Relative Advantage* *Ease of Use* *Result Demonstrability* *Trialability* *Visibility* *Image* *Compatibility*
Decomposed Theory of Planned Behaviour (Taylor & Todd, 1995)	*Behavior* *Behavioral Intention* *Attitudes* *Subjective Norms* *Perceived Behavioral Control* *Perceived Usefulness* *Perceived Ease of Use* *Compatibility* *Peer Influence* *Superior Influence* *Resource Facilitating Condition* *Technology Facilitating Condition* *Self-Efficacy*

Table 3 Models of user acceptance developed
Adapted from (Venkatesh, 1998)

Each model improves or adapts certain constructs to better fit the setup and focus of their studies. While some models offer clear advantages like the DTPB with its deeper explanatory support of the intentions, the models were compared and tested, reaching conclusion about the performance of TRA, TPB, DTPB and TAM in relation to each other in terms of prediction of the behavior shown comparably similar (Venkatesh, 1998).

From the available models to explain adoption and behavior, both DTPB and TPB have a significantly more complex implementation than TAM (5 variables), but not as time consuming and expensive as TRA (Fishbein & Icek, 1975). Nonetheless, TPB, compared to the other models, has explanatory levels adequate to the current study for a technology like NTFs, which can be described as a data/information oriented innovation, and the intentions explained by the TPB adapt better for this research (Venkatesh, 1998).

NFTs as an application of Blockchain against counterfeits can be framed as a study of acceptance and application of technological innovation (Davis et al., 1989). From the different models exposed previously, the best relation of validity explanation and predictive capacity can be reached by analyzing this study under the scope of acceptance and implementation of a new technology (Venkatesh, 1998). While other approaches may also prove suitable for intentions when there are proven advantages to the implementation of the innovation a direct approach with other models different to the TPB, they will not necessarily carry deeper determinants of the final behavior intention (Chiu & Wang, 2008; Davis et al., 1989; Taylor & Todd, 1995).

TPB, which was originally developed by Icek Ajzen (**Fig. 4**), dictates that the performance of a behavior is a joint execution of intentions and perceived behavioral control, where the measure of intention and Perceived Behavioral Control must correspond or be compatible with the behavior that is to be predicted (Ajzen, 1991).

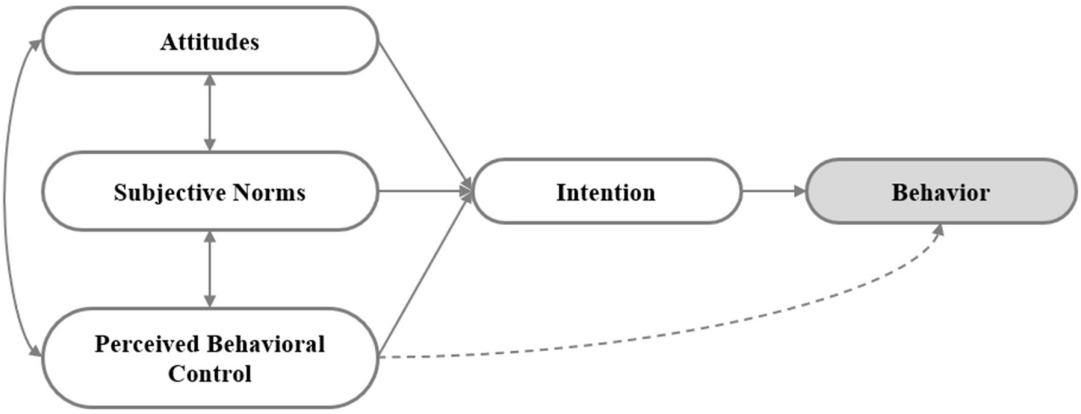

Figure 4 Theory of planned behavior
(Ajzen, 1991)

This model was proposed to remedy the poor predictive validity of attitudes and traits, as an aggregation of specific behaviors across occasions, situations, and forms of action (Ajzen & Fishbein, 1980). The idea of this principle was the assumption that any sample of behavior reflects the influence of a relevant general disposition, and the influence of various other factors, unique to each occasion, situation and action being observed (Fishbein & Icek, 1975). This framework was used in studies to understand consumer purchase intention for blockchain traceable coffee (Dionysis et al., 2022), and the motives towards choosing traceable food in two different European countries, Italy and France (Menozzi et al., 2015), and, therefore, constituting a suitable core for this analysis.

The TPB model's predictive power, in the context of consumer choice, has been adapted over the years. Following the author of the original model encouragement, as he suggests in his documents, the TPB was open to additional predictors whenever they can be shown to capture a significant proportion of the variance in intention or behavior (Ajzen, 1991). This exploration of a new predictor had, as a result, the integration of Trust and Habits, contributions made in the field of traceable food (Spence et al., 2018) and coffee (Kyung et al., 2015).

These contributions observed in the context of consumer choice and traceability of products supporting that the TPB model benefits from the addition of the predictors Trust and Habits. Consequently, this study of NFTs as a certification method for physical products encounters a solid theoretical foundation as a proven model to predict consumers' intentions of traceable food, which is adapted to certificated and traceable products. This was made possible by the application of NFTs as a trustworthy mechanism for storing all records of a product fabrication and transactional history (Trautman, 2021).

Consumer's confidence in the ability to understand and find the information of a product was proven to show a strong connection to the final buying intention in studies relating traceable food (Rijswijk et al., 2008). In this regard, NFTs facilitate the implementation of certificates and traceability, previously made in paper. This assurance of transparency and trust from the brand was observed to create a long-term relationship, driven by the belief in the information made available by the certificate now in the shape of an NFT (Kolesnikov-Jessop, 2019). Therefore, it is possible to assume that the Behavioral Belief will have a positive impact in the final intention of purchase, and thus:

H1. The intention of purchase of an NFT-certificated product is positively influenced by the Behavioral Beliefs.

Attitudes and how they affect the intention towards counterfeit consumption finds theoretical background in previous studies, where the perceived wrongness of the consumption of counterfeits is perceived in an increasing level, as the consumer has a higher awareness of the wrongness of the activity (Cordell, 1996). As appointed by (Bian & Veloutsou, 2007), attitudes towards counterfeits were observed to have a stronger positive influence only due to their lower cost of purchase. Nevertheless, the increased risk of penalty of the purchase significantly decreased the willingness to buy them. Other pieces of evidence that attitudes are determining factors under the scope of the TPB model relate to the context of the implementation of a new technology such as NFTs (Bruijn, 2010). As the use of NFTs could drastically reduce the possibility of counterfeits and false information about the products, the attitudes from the consumers towards this positive outcome could influence the final intention of purchase for the NFT-certificated product (Evans et al., 2019), which supports the following hypothesis:

H2. The more favorable the attitude towards NFTs, the stronger the intention to purchase a product certified by them.

Depending on the topic of the study, the Subjective Norms, manifesting as the opinion of the scientific community, the media, others, etc., have a strong influence on the final buying intention (Dionysis et al., 2022). Additionally, solid evidence of the potential strength of the Subjective Norms in the consumption of counterfeits can be observed as a proven socially-oriented motive in the TPB model. As appointed by a recent study, ethical considerations and embarrassment exhibit a strong effect on the intention to consume or buy counterfeit products (Molina-Castillo et al., 2021). Therefore:

H3. Subjective Norms effectively affect the intention to buy an NFT-certificated product.

Supporting the TPB model, the PBC and the intentions have been proven to be directly linked to predict the behavior in various studies (Taylor & Todd, 1995; Venkatesh, 1998). It has been

established in the literature that greater PBC can be associated with stronger purchase intentions (Armitage & Conner, 2010). Following the previous findings, it will be the interest of brands to know and raise the levels of Perceived Behavioral Control and attitudes towards the use of NFTs as a certification method (Verbeke & Ward, 2006). As some industries already experience, if two individuals have equally strong intention to buy an NFT-certificated product and both seek it, the person who is confident in the benefits of the technology is more likely to achieve the purchase rather than the person in doubt (Butcher, 2018; Taylor & Todd, 1995), stating the fourth hypothesis:

H4 The level of PBC will positively influence the consumer's intention to purchase.

Subjective Norms are brought to the TPB from the initial development of the TRA (Ajzen & Fishbein, 1980). They refer to the individual perception of the general social pressure to perform (or not to perform) the behavior. If the consumer perceives that significant others endorse or disapproved the behavior, their intent to perform it will be, respectively, more or less likely (Armitage & Conner, 2010). As this study deals with a relatively new technology, such as the implementation of NFTs as a certification method, evidence of the connection between Attitudes, Behavioral Beliefs and PBC was established in the extended TPB model elaborated for the study of traceable coffee (Menozzi et al., 2015). The author concluded in his study that Subjective Norms were a significant determinant of the buying intention, because even when positive levels of Attitudes, Beliefs and PBC were a solid start for determining the buying intentions, other social factors (Subjective Norms) were key in the decision-making process. Therefore, the final intention will effectively reflect the general social pressure towards the use of NFTs after the validation of Attitudes, Beliefs and PBC, and this supports the following hypotheses:

H5. Behavioral Beliefs positively influence Subjective Norms.
H6. Attitudes towards the use of NFTs positively influence Subjective Norms.
H7. PBC of the use of NFTs as a certification mechanism positively influences Subjective Norms.

In a purchase intention, attitudes alone may not be the only factor affecting the action; habits, and past behavior may also be important predictors of the future behavior (Ajzen, 1991; Ajzen & Fishbein, 1980; Fishbein & Icek, 1975). If past behaviors could be a frequency measure,

habits have significant effects on buying intentions (Honkanen, Olsen, et al., 2005; Honkanen, Svein Ottar, et al., 2005). Further studies also explored the effect on the final intention of buying and adoption of new technologies, reaching the conclusion which plays a critical role in the overall intention (Davis et al., 1989; Venkatesh, 1998). Consequently, the next hypothesis is developed:

H8 Habits towards certification methods influence the final buying intention of NFT-certificated products.

There is an unquestionable relationship between Trust and consumer interaction with a brand (Kshetri, 2018). On the application of the TPB for the study of consumers intentions, recent literature appoints the increased predictive outcome of the model when Trust is adapted to it (Kyung et al., 2015; Menozzi et al., 2015; Spence et al., 2018). The use of NFTs as certifications has its roots in the need of trust and the problem of counterfeiting itself, from the supply chain to the commercialization of the products; a problem that can be solved by its application (Treiblmaier, 2021). As the benefits of the NFT application become more known to consumers, the levels of favorability increase, based on the trust in the NFT certification to retrieved trustworthy information about the products and effectively affecting the purchase intention in the model (Dionysis et al., 2022). With this support the final hypothesis can be established:

H9. The higher level of Trust in the NFT certificates, the stronger the purchase intention.

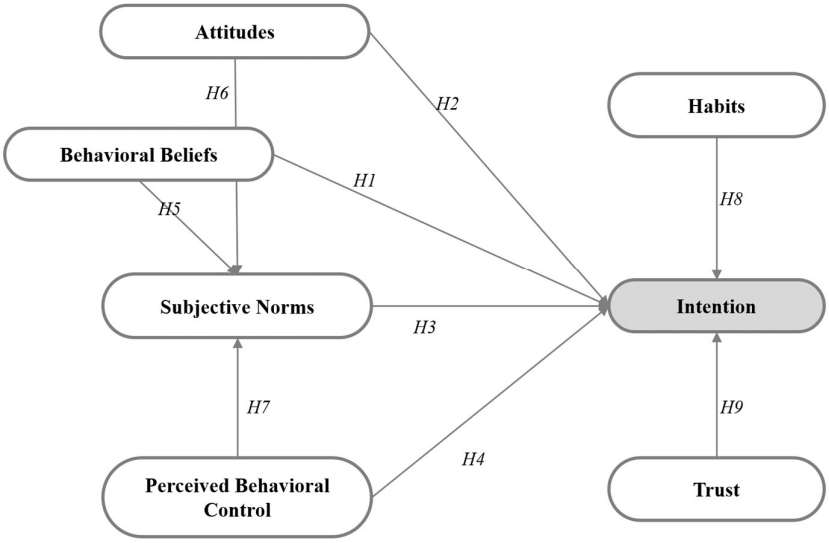

Figure 5 Proposed Model Adapted from the extended model of TPB
(Menozzi et al., 2015) applied by (Dionysis et al., 2022) in the study of Blockchain traceable coffee - Original model of Theory of Planned Behavior (Ajzen, 1991).

4. Methodology

4.1. Measures

To assess the impact of the use of NFTs as a certification or authenticity assurance of physical products in the fight of deceiving counterfeit consumption, the following questionnaire was developed based on the Theory of Planed Behavior (TPB) and the extended TPB structure (Venkatesh, 1998) for the selection and composition of the questions. The questionnaire is constituted by closed-ended questions and statements are measured on a Likert-type scale of seven points where 1 represents “Strongly disagree” to 7 “Strongly agree”. Additionally, the guidelines established by a previous study in the purchase intention of blockchain traceable coffee (Dionysis et al., 2022) were followed to shape the TPB model in an NFT purchase intention scenario.

With the aim of measuring the attitudes towards the use of NFTs as a certification of a physical product vs other types of certifications (QR Codes, Stickers), the cognitive and affective aspects of the attitude were measure in a semantic differential composed by absurd-ingenious, intricate-practical (Cognitive) and embarrassed-proud, doubtful-confident (affective) (Dionysis et al., 2022). Behavioral Beliefs were measured with seven statements where the respondents needed to compare a product certified by an NFT with a product certified by current methods (QR Codes, Stickers and paper certificates) and determine whether it will be more trustworthy, easier to know its sourcing, easier to track its records, more expensive, better preserve the value, deepen the connection with the brand and harder to counterfeit. For the measure of the Subjective Norms, five dimensions were taken into consideration, namely family, tech community, media, important others and the industry. The perceived ability to understand the blockchain traceability benefits represents the Perceived Behavioral Control (PBC) as the ease or difficulty to perform the behavior were measured by 6 items adapted from the previous study in the purchase intention of blockchain traceable coffee (Dionysis et al., 2022).

The purchasing habits were catalogued and recorded in 4 dimensions: retailer relationship, counterfeits awareness, transaction history and certification preference. For the evaluation of the trust, five items were taken into consideration: trusting the retailer, trusting the product authenticity, trusting the transaction history, trusting the accessibility of the records and trusting the records. And, finally, Purchase Intention was measured by three degrees of interest, namely:

"I intend to buy it", "I will look for it", and "it will be important to me to buy it". (Ajzen, 1991; Kyung et al., 2015; Spence et al., 2018) (**Table 4**).

Attitudes (4 items)
By buying products endorsed by Non-Fungible Tokens (NFTs) as a method of authenticity certification I would feel (Likert-type scale): 1. Embarrassed (1) / Proud (7) 2. Doubtful (1) / Confident (7) *Compared with other methods of product certification, such as QR codes, stickers and paper certificates. I think that buying products certified by NFTs is (Likert-type scale):* 3. Absurd (1) / Ingenious (7) 4. Intricate (1) / Practical (7)
Behavioral Beliefs (7 Items)
Regarding NFT certifications, in comparison to other methods available (QR codes, stickers and paper certificates): 1. Products certificated by NFTs will likely be preserving better its value 2. Products certificated by NFTs will likely be more expensive 3. Products certificated by NFTs will likely be safer to rely on its authenticity 4. Products certificated by NFTs will likely be of known origin 5. Products certificated by NFTs will likely be easier to track its transaction records 6. Products certificated by NFTs will likely be harder to counterfeit 7. Products certificated by NFTs will likely create a deeper connection with the brand
Subjective Norms (Social pressure – 5 Items)
I would be inclined to buy products with NFT certifications because: 1. My family and friends approve it 2. The tech community is in favour of it 3. The media (social media, TV, radio) are in favour of it 4. People important to me or whom I admire buy/prefer it 5. The marketplaces where the products are sold are in favour of it
Perceived Behavioral Control (PBC – 6 Items)
In regard to obtaining information about the product, such as certification and transaction records with the NFT and the blockchain functionality: 1. It will be simple to obtain the information 2. I will be confident about the information contained within the blockchain records 3. I will be able to find all the product-related information without the help of others 4. It will be easy to understand the information contained in the records 5. I will be confident that I will find the information always available 6. I will be able to understand all the product-related information without the help of others
Habits (12 Items)
Origin – When I buy a product, searching for information about the store or marketplace where it is being sold is something that: 1. I do it automatically 2. I do it without consciously considering it 3. I start doing it before I realize I am doing it 4. I do it without thinking

Counterfeits awareness - When I buy a product, looking for indications or proofs of its originality is something that: 1. I do it automatically 2. I do it without consciously consider it 3. I start doing it before I realize I am doing it 4. I do it without thinking *Certification - When I buy a product, checking the authenticity methods that are displayed (such as stickers, QR codes and paper certificates) is something that:* 1. I do it automatically 2. I do it without consciously consider it 3. I start doing it before I realize I am doing it 4. I do it without thinking
Trust (3 Items)
I trust: I trust that the NFT-certificated product can be tracked back to the actual factory I trust in the information provided about the production process and origin of the NFT-certificated product I trust that the product certified by NFT is authentic, which means it has not been tampered with in any way and is what it says it is
Intentions (3 Items)
When NFT certifications becomes available: 1. I intend to buy it 2. I will look for it 3. It will be important for me to buy it

Table 4 Conceptual model items
Adapted from the extended model of Theory of Planned Behavior (Menozzi et al., 2015) and the further application of the model by (Dionysis et al., 2022) in the study of blockchain traceable coffee

5. Analysis and Results

5.1. Sample and Pre-test

Before implementing the questionnaire, a pilot survey was conducted. This first validation allowed to judge whether the questionnaire required changes or modifications and that the scales for each variable were structured correctly. The revision was developed in discussion with senior academics certifying that the questions were concise, clear, and relevant for the study. Finally, after this initial pilot, the complete questionnaire was released online and, during the lapse of 2 months, the answers were gathered using Facebook groups and Twitter with topics related to Blockchain and NFTs. After the first month of collecting answers, the Amazon Mechanical Turk (Amazon, 2022) platform was used in order to gather the remaining number of answers and start the analysis, filtering within the platform the requirements which each respondent must have accomplished in order to be given the survey. For this aim, the

requirement was to be an active participant in the financial market and an active user of Twitter, as this is the primary social network for Blockchain.

The research object was open to the global consumer with notion of NFTs and it was not a requirement to have deep knowledge of the topic. From the summary of the samples' demographics presented (**Table 5)**, a total of 310 surveys was recorded, with 49.4% female respondents and 50.6% male respondents. Most of the participants (72%) were between the ages of 18 and 40 years old, and most of the sample held a bachelor's degree (70.3%) with 18.4% having a master's degree. Previous knowledge about NFTs or Blockchain in general was not a determinant factor in the criteria for the respondents to the survey and a simple explanation was given in the introduction of the questionnaire. Nevertheless, 95% of the participants confirmed having heard and known about the topic in advance; in regard to counterfeits, 87% had information about using NFTs as a counterfeit measure.

	Demographics	%
Age	*18-30*	34.5%
	31-40	38.1%
	41-50	14.8%
	51-60	10.0%
	> 60	2.6%
Gender	*Male*	50.7%
	Female	49.0%
	Prefer not to say	0.3%
Education	*Primary education*	1.3%
	Secondary education	9.4%
	BSc Degree	70.3%
	MSc Degree	18.4%
	PhD	0.0%
	Prefer not to say	0.6%
Employment	*Full time*	94.2%
	Part time	2.9%
	Unemployed	1.3%
	Student	1.0%
	Prefer not to say	0.6%
Internet usage	*More than 8h a day*	11.3%
	Between 2h and 4h a day	45.5%
	Between 4h and 8h a day	33.5%
	Less than 2h a day	9.7%

Are you familiar with NFTs or Blockchain?		
	Yes	95.5%
	No	4.5%
Have you ever heard of Non-Fungible Tokens (NFTs)?		
	Yes	95.8%
	No	4.2%
Do you know that NFTs prevent risks of counterfeiting?		
	Yes	87.4%
	No	12.6%
Do you know that NFTs record the production of a product and track all transactions?		
	Yes	88.7%
	No	11.3%
Do you know that an NFT can provide previous information about the corresponding digital asset to consumers?		
	Yes	87.1%
	No	12.9%

Table 5 Demographic and previous knowledge

5.2. Data Preparation and Treatment

The data analysis was conducted using a partial least square structural equation modeling (PLS-SEM) with SmartPLS 3 to check the model. This approach provides a fitting analysis to understand the individual constructs or items and the cause–effect relations among all of them (Hair et al., 2010). This study applies the resampling procedure (Bootstrapping) to 5000 resamples.

5.3. Outer Model Results

For the final model, one item from Behavioral Beliefs and one item from Subjective Norms were removed because of their low Outer Loadings (0.570 and 0.334, respectively) a second calculation without these two items validated that all other Outer Loadings are above 0.7 and statistically significant ($p < 0.001$). Average Variances Extracted (AVE) are all greater than 0.5 for all variables. Adding these two results (Outer Loadings and AVE), the indicators can be assumed to have a high reliability (**Table 6**).

As it can be noted in **Table 6**, the variables BB2 and SN5 presented a loading between the range 0.40-0.7. Their removal gave an increase in the composite reliability and, therefore, both indicators were removed from the final model following the suggestions of (Hair et al., 2010).

In this study, composite reliability is preferred to Cronbach's alpha as a test of convergent validity (Hair et al., 2010), which leads to higher estimates of true reliability. In an adequate model for confirmatory purposes, composite reliabilities should be greater than 0.70, and values equal or greater than 0.80 would be considered good for confirmatory research (Daskalakis & Mantas, 2008). For the Convergent Validity test, all the construct loadings concerning the AVE were superior to the advised 0.50 (Hair et al., 2010).

Variable/Item	*Mean*	*SD*	*F. Loadings (i)*	*F. Loadings (ii)*	*Alpha*	*CR*	*AVE*
Attitudes ATT (4 Items)					**0.88**	**0.92**	**0.74**
ATT1 Bad (1)– good (7)	5.60	1.17	0.871	0.872			
ATT2 Displeased (1)–pleased (7)	5.54	1.31	0.873	0.873			
ATT3 Foolish (1)–wise (7)	5.39	1.29	0.840	0.840			
ATT4 Harmful (1)–beneficial (7)	5.54	1.28	0.846	0.846			
Behavioral Beliefs BB (7 items)					**0.90**	**0.92**	**0.63**
BB1 A. Products certificated by NFTs will likely be more appealing	5.50	1.30	0.853	0.868			
BB2 B. Products certificated by NFTs will likely be more expensive **(*)**	5.48	1.19	**0.570**				
BB3 C. Products certificated by NFTs will likely be of known origin	5.48	1.24	0.810	0.811			
BB4 D. Products certificated by NFTs will likely be safer to rely on its authenticity	5.52	1.15	0.815	0.810			
BB5 E. Products certificated by NFTs will likely be of more satisfying quality	5.43	1.34	0.839	0.852			
BB6 F. Products certificated by NFTs will likely be authentic which means it has not been tampered with in any way and it is what it says it is	5.42	1.18	0.758	0.746			
BB7 G. Products certificated by NFTs will likely have higher production standards	5.50	1.25	0.864	0.869			
Subjective Norms SN (5 items)					**0.80**	**0.87**	**0.59**
SN1 A. My family and friends approve it	5.36	1.48	0.837	0.845			
SN2 B. The tech community is in favor of it	5.56	1.30	0.839	0.842			
SN3 C. The media (social media, TV, Radio) are in favor of it	5.34	1.40	0.845	0.841			
SN4 D. People important to me or, whom I admire buy/prefer it	5.33	1.36	0.835	0.847			
SN5 E. The marketplaces where the products are sold are in favor of it **(*)**	5.33	1.41	**0.334**				
Perceived Behavioral Control PBC (6 items)					**0.89**	**0.91**	**0.64**
PBC1 A. It will be simple to obtain the information	5.57	1.11	0.766	0.767			
PBC2 B. I will be confident about the information contained within the blockchain records	5.61	1.12	0.790	0.790			
PBC3 C. I will be able to find all the product-related information without the help of others	5.56	1.13	0.785	0.785			
PBC4 D. It will be easy to understand the information contained in the records	5.43	1.21	0.792	0.792			
PBC5 E. I will be confident that I will find the additional information	5.49	1.21	0.841	0.841			
PBC6 F. I will be able to understand all the product-related information without the help of others	5.35	1.23	0.812	0.812			
Habits: Origin HO(4 items)					**0.82**	**0.88**	**0.65**

HO1 A. I do it automatically	5.44	1.27	0.758	0.758			
HO2 B. I do it without consciously considering it	5.22	1.51	0.829	0.829			
HO3 C. I start doing it before I realize I am doing it	5.33	1.39	0.819	0.819			
HO4 D. I do it without thinking	4.91	1.74	0.822	0.822			
Habits: Counterfeits awareness HCA (4 items)					**0.85**	**0.90**	**0.69**
When I buy a product, looking for indications or proofs of its originality, is something that:							
HC1 A. I do it automatically	5.41	1.33	0.798	0.798			
HC2 B. I do it without consciously considering it	5.10	1.53	0.844	0.844			
HC3 C. I start doing it before I realize I am doing it	5.23	1.49	0.850	0.850			
HC4 D. I do it without thinking	4.95	1.71	0.832	0.832			
Habits: Certification HC(4 items)					**0.88**	**0.91**	**0.73**
HCT1 A. I do it automatically	5.21	1.43	0.840	0.840			
HCT2 B. I do it without consciously considering it	5.13	1.59	0.853	0.853			
HCT3 C. I start doing it before I realize I am doing it	5.28	1.44	0.877	0.877			
HCT4 D. I do it without thinking	4.84	1.64	0.840	0.840			
Trust (3 items)					**0.85**	**0.91**	**0.77**
TRUST1 A. I trust that the NFT-certificated product can be tracked back to the actual factory	5.46	1.32	0.904	0.904			
TRUST2 B. I trust in the information provided about the production process and origin of the NFT-certificated product	5.35	1.27	0.859	0.859			
TRUST3 C. I trust that the product certified by NFT is authentic, which means it has not been tampered with in any way and is what it says it is	5.40	1.26	0.873	0.873			
Intentions INT (3 items)					**0.90**	**0.94**	**0.83**
INT1 A. I intend to buy it	5.25	1.41	0.926	0.926			
INT2 B. I will look for it	5.48	1.41	0.893	0.893			
INT3 C. It will be important to me to buy it	5.26	1.44	0.920	0.920			

Table 6 Reliability and validity test
(*) removed items from the final model due to low F. Loadings

Finally, confidence intervals for the Heterotrait-Monotrait ratio (HTMT) of the correlations between the reflective constructs were lower than 0.85, showing discriminant validity for all constructs (Hair et al., 2010). Further detail of the values obtained are displayed in **Table 7**.

	Attitudes	Behavioral Beliefs	Habits	Intentions	PBC	Subjective Norms	Trust
Attitudes							
Behavioral Beliefs	0.813						
Habits	0.535	0.613					
Intentions	0.671	0.752	0.702				
PBC	0.731	0.789	0.656	0.766			
Subjective Norms	0.663	0.725	0.633	0.745	0.792		
Trust	0.683	0.800	0.654	0.812	0.780	0.654	

Table 7 Heterotrait-Monotrait (HTMT) ratios

5.4. Inner Model Results

For the inner model analysis, the items corresponding to the three variables measuring the Habits (Certification, Counterfeits Awareness and Origin) were having correlation issues when analyzing the HTMT ratios (**Table 9**). Therefore, the creation of a subdimension for the model could potentially eliminate the correlation discrepancy as suggested by (Henseler et al., 2009).

	ATT	BB	HC	HCA	HO	INT	PBC	SN	Trust
ATT									
BB	**0.904**								
HC	0.618	0.694							
HCA	0.544	0.603	**0.997**						
HO	0.571	0.645	**0.928**	0.962					
INT	0.753	0.820	0.804	0.718	0.727				
PBC	0.827	0.872	0.716	0.679	0.732	0.856			
SN	0.758	0.810	0.757	0.629	0.673	0.844	**0.903**		
Trust	0.788	**0.911**	0.747	0.670	0.741	**0.925**	0.897	0.759	

Table 8 HTMT ratios before subdimension

	Intentions	Subjective Norms
Trust	3.606	
Subjective Norms	3.307	
PBC	4.62	2.824
Intention		
Habits: Origin	3.384	
Habits: Counterfeits Awareness	4.765	
Habits: Certification	**5.409**	
Behavioral Beliefs	4.898	3.872
Attitudes	3.168	3.15

Table 9 Inner VIF Results before subdimension

Due to the previously mentioned correlation discrepancy, an integration of the item Habits (certification, counterfeits awareness and origin) was conducted following the suggested steps (Henseler et al., 2009). The construction of this subdimension solved the problems of correlation as the HTMT ratios confirm in **Table 10** and **Table 11**.

	ATT	BB	Habits	INT	PBC	SN	Trust
ATT							
BB	0.813						
Habits (Subdim)	0.535	0.613					
INT	0.671	0.752	0.702				
PBC	0.731	0.789	0.656	0.766			
SN	0.663	0.725	0.633	0.745	0.792		
Trust	0.683	0.800	0.654	0.812	0.780	0.654	

Table 10 HTMT ratios with subdimension

	Intentions	Subjective Norms
Trust	3.551	
Subjective Norms	3.054	
PBC	4.408	2.824
Intention		
Habits	**2.038**	
Behavioral Beliefs	4.863	3.872
Attitudes	3.164	3.15

Table 11 Inner VIF Results with subdimension

The results of the SEM Analysis by using the training sample are presented in the **Figure 6**. For this study the Standardized Root Mean Square Residual (SRMR) of the model is 0.018, indicating a good fit (being the SRMR lower than 0.08). The standardized path coefficients (β) and the p-values (inside parentheses) predict a variance of 65.2% (R^2) in the variable intentions, and the items in the model explain 65.2% of the total variation of the construct.

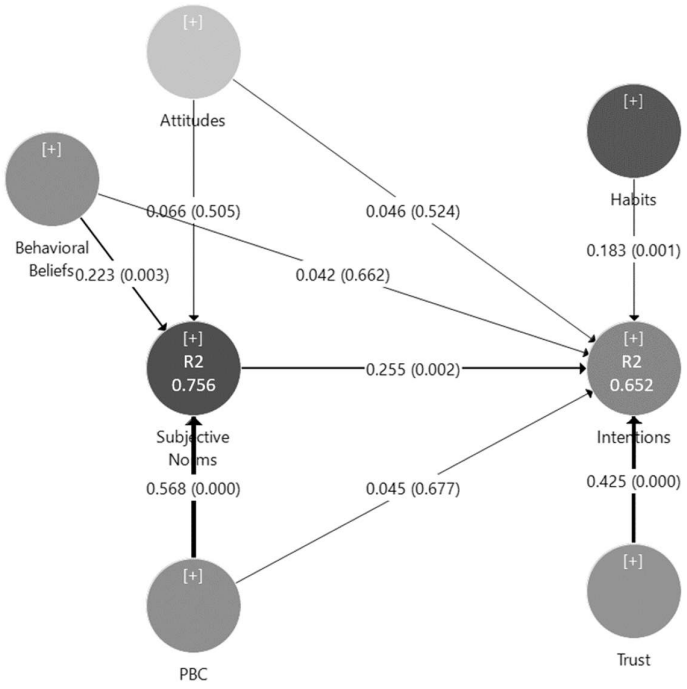

Figure 6 PLS-SEM Standardized Path Coefficients and (p-values)

6. Discussion

The research aim of this dissertation was (1) to research what is the consumer's purchasing intention for NFT-certificated products and the psychosocial antecedents of these intentions in the fight against deceptive counterfeit, and (2) to study how the Beliefs, Subjective Norms and

Perceived Behavioral Control (PBC) influence the intention to purchase NFT-certificated products.

The authentication of content by the use of Blockchain technology has been an emerging topic in the academic field. Its application has been explored as an alternative for digital content accreditation, due to the difficulty to endorse it, and which represents a higher risk of misrepresentation (Chohan & Paschen, 2022). Other publications have also appointed how, since 2021, the coverage of information about Blockchain and NFTs has started to reach more mainstream media like printed, online and television. Mentions of both topics have increased exponentially, bringing more attention to their advantages and possible applications (Dowling, 2022; Kshetri, 2018; Perez, 2017; Szilagyi, 2021).

As this study approached a relatively new topic for the potential consumers, the methodology was based on previous studies where NFTs and physical products were the scope of the analysis (Dionysis et al., 2022). The Theory of Planed Behavior (TPB) proposed by Ajzen (Ajzen, 1991) was applied following the theorical framework using the PLS-SEM algorithm to evaluate the TPB model.

First, the results indicate that Behavioral Beliefs are not a driver for the final purchase intention of an NFT-certificated product, having no significant effect on the intention (β=0.042 and p-value=0.662), contrary to the proposed theory by previous research (Rijswijk et al., 2008). As a result of this finding, the **Hypothesis 1** is not supported. This can be explained by the fact that the TPB model is affected by the Beliefs at the time of the analysis (Armitage & Conner, 2010). Furthermore, the application of NFTs and Blockchain can be categorized as an emerging technology, where past behavior contributes to the foundation of beliefs (Ouellette & Wood, 1998). Until now, consumers have not developed enough knowledge or familiarity in order to create a strong foundation that could potentially lead to a significant relation among Behavioral Beliefs and Intention (Bagozzi et al., 1989; Fishbein & Icek, 1975).

Attitudes towards the Intention of purchase of NFT-certificated products (β=0.046 and p-value=0.524) do not have a significant effect, rejecting the **Hypothesis 2**, because it cannot be proved to be an effective driver. There is literature supporting this finding, and there is evidence that suggests the distinction between two types of individuals, in a model predicting intention base on the TPB. The intentions of the first type are driven primarily by attitudes, whereas the

intentions of the second type of individuals are driven in a greater proportion by Subjective Norms (Trafimow & Finlay, 1996).

The previous finding suggests a better prediction of the purchase intention in the model of the Subjective Norms (β=0.255 and p-value=0.002). With these results, it can be established that there is a significant positive effect between the Subjective Norms and the Intention of purchase for NFT-certificated products, validating and confirming the **Hypothesis 3**. This allows to assume that the higher the level of Subjective Norms perceived by consumers, the higher the level of purchase intention of an NFT-certificated product. There is also strong evidence that supports this finding in the literature. The process of influence in the purchase intention can be explored in a scenario where a peer suggests the use of a new technology (an NFT certification). The person, rather than yielding to the social pressure, would examine why he/she is being suggested the use of the technology, discuss it with the peer, and may reach the conclusion that he/she is being suggested it because the peer believes the new technology is useful. This process will lead to the person internalizing the idea that the technology is useful, and this usefulness will drive the behavior towards the Intention (Armitage & Conner, 2010). This finding confirms that the perception of social pressure and judgements of others has a strong weight on the motivation to comply with this judgement, and therefore is a determinant factor in the intention to use NFT-certificated products.

Moving forward in the model, the PBC can be concluded to not have a significant effect on the purchase intention (β=0.045 and p-value=0.677), rejecting **Hypothesis 4**. This means there is no evidence of PBC effectively affecting the consumer's intention, despite the TPB model explaining a favorable disposition of the individuals to have a positive intention for behaviors that are believed to be easier to understand (Ajzen, 1991). Nevertheless, the low predictive power of PBC in the purchase intention of NFT-certificated products corresponds to the relative importance of the previously confirmed Subject Norms. As other authors state, the influence of PBC on the model is expected to vary across situations where attitudes or Subjective Norms are strong (Ajzen, 1991; Armitage & Conner, 2010). Further analysis shows that the weight of the PBC on the model is also affected by the consumption and familiarity with the product (Bruijn, 2010). Since this study relates to a new application of a technology currently not available to the participant, the lack of familiarity played an important factor in the model. As NFT applications evolve and start to appear in more mainstream applications (Butcher, 2018; Salman et al., 2019; Trautman, 2021), the PBC could play a different role in future models.

Between Behavioral Beliefs and Subjective Norms, the results report evidence of a significative positive effect (β=0.223 and p-value=0.003), accepting the **Hypothesis 5**. However, the results between Attitudes and Subjective Norms (β=0.066 and p-value=0.505) do not find support for the **Hypothesis 6** and it is rejected**.** Next concerning PBC and Subjective Norms (β=0.569 and p-value=0.000) there is evidence of a positive effect on the Subjective Norms, accepting the **Hypothesis 7**. The previously mentioned hypotheses are also supported by the previous findings in the purchase intention of traceable coffee, where Subjective Norms and PBC are proven to be related and valid predictors in the authors' model (Dionysis et al., 2022).

Following the last hypotheses, the relationship between Habits and Intention (β=0.183 and p-value=0.001) do show positive results, and, therefore, Habits do have a significant effect on the Intention. As a result, and in accordance with the theoretical support (Honkanen, Olsen, et al., 2005), the **Hypothesis 8** is accepted. Since Habits heavily depend on past behavior and following the literature relating the implementation of new technologies (Farshid et al., 2018; Venkatesh, 1998), for the current model, there is not enough past behavior to relate Habits as the strongest driver in the Intention.

Finally, the relationship between Trust and the Intention shows positive results (β=0.425 and p-value=0.000), representing a significant effect on the purchase Intention, therefore the **Hypothesis 9** is accepted, which was also find in a previous study relating Blockchain applications (Sander et al., 2018). Trust is defined as the confidence of one person towards the trustworthy aspect of another, a kind of psychological expectation that the other person will not harm the self-interest (Kim et al., 2008). Trust in this study refers to the level of confidence consumers show in the NFT certifications, and as the results confirm, higher levels of trust in the NFT certification are translated into higher levels of purchase intention. A similar scenario supports this finding. In the research of traceable food, the authors confirm that consumers' trust of the product traceability positively affects the final intention (Nie & Luo, 2019).

Theoretically, the model proposed for the intention of buying NFT-certificated products can predict the individuals' Intentions and the levels of significance of each. Literature confirms that consumers do benefit from improved traceability, reduction of the risk and improvement in information supplied by the companies (Fishbein & Icek, 1975). Nevertheless, according to the proposed TPB model, this study shows that positive attitudes towards NFTs as a mechanism of certification are not significative enough in the model to affect the purchase intention of the

consumers. The explanation of why these levels of attitude do not affect the intentions might be the early stages of the Blockchain and NFT development. It is still a speculative area for many, and before going for a technology that is still not mainstream, people seek a census among the opinions of others. Even when big companies are already vouching for Blockchain developments (Griffin, 2018), the lack of references on the market makes the consumer first filter their attitudes through the opinions of others.

7. Conclusions

The present work is one of the few existing studies relating NFTs as a certification of physical objects, as NFTs are a relatively recent technology and most of the existing literature focuses primarily on the digital applications. Other studies have emerged and been built around the implementation of new technologies, such as Virtual Reality (VR) (Farshid et al., 2018), Artificial Intelligence (AI) (Paschen et al., 2022), and other advances in computation (Davis et al., 1989). Nevertheless, this work builds on the foundations given by (Menozzi et al., 2015) in the study of traceable food using Blockchain through the supply chain, and (Dionysis et al., 2022) for the application of this traceability to the coffee market.

Based on the existing literature covering the application of NFTs as certification of physical products, the present study attempts to cover some of the identified gaps and makes several important contributions.

First, as limited research exists on the intention to purchase products certified by Blockchain or NFTs, most studies relate to digital ownership and marketing (Butcher, 2018; Chohan & Paschen, 2022; Farfield, 2021). The present study extends the literature with the application of the Theory of Planed Behavior (Ajzen, 1991) to the application of NFTs into existing market problems, such as counterfeiting, and, by doing so, this study is one of the first to consider the purchase intention of NFTs.

Second, the existing research focuses mainly on the Blockchain and does not appoint NFTs as the pilar of the study (Chierico, 2017; Kshetri, 2018; Trautman, 2021). By primarily exploring the use of NFTs as a certification of physical items, this study manages to explain their attributes, which make them ideal to this purpose. By doing so, it highlights the opportunity present in the counterfeit fight to implement this technology and finally achieve a viable solution to the fight.

Third, the literature about NFTs and their applications by brands is limited and mostly focused on digital marketing applications and digital ownership (Bao & Roubaud, 2022; Farfield, 2021; Griffin, 2018; Wang et al., 2021). To the best of the author's knowledge, no previous study has explored the effects on consumers' intentions and the application of NFTs in the certification of physical objects. As significant literature exists in relation to digital ownership, this study expands the focus of the study to the physical world, where its uses can be as wide as they are currently digitally developed.

After analyzing the results in the previous section, the following managerial implications can be derived, which might help to guide the development of future uses for NFTs as certification of physical products, considering the key findings from consumers.

- *Transparency and trust*

The initial applications of Blockchain found in managerial studies come from the necessity of supply chains to give transparent and better information to consumers. The need to make this trustworthy data available to the final user drove the attention towards the advantages of Blockchain. Despite being in a premature state, the application of NFTs to certify physical products (Butcher, 2018), this study shows that Trust in Blockchain and the NFT application exists, and companies should start building on these new technologies the new channels of communication and information with their customers. As they perceive higher levels of trust, it will be important to explore the possibilities of the world's digitalization (Kugler, 2021) to tackle latent issues such as counterfeiting, certification, and supply chain transparency, which can be achieve with the help of NFTs.

- *Communication*

The current findings show that even though consumers have positive attitudes towards the use of NFTs as a certification, when a new technology is in the initial stages of the introduction to the market, there is a stronger influence in the shape of Subjective Norms that have a bigger repercussion on the final model of planed behavior (Davis et al., 1989; Moore & Benbasat, 1989). These Subjective Norms, which are present in the opinion of other people surrounding the target consumer, will need to be given the right attention by brands, as the challenge to communicate and educate the consumer will not be only required to them. The challenge will also be to raise the positive influence that other people have on the target consumer to generate the desired purchase intention (Venkatesh, 1998). Companies need to be clear and explain in

detail the uses and advantages that NFTs can bring to the consumers. The usefulness perception of the technology needs to reach consumers and his/her peers, as during the social interaction the potential consumers need to reach the conclusion that the NFTs are useful for them (Kim et al., 2008).

As the applications of NFTs continue to grow in the digital world, and start to infuse the physical one, the new interactions that are generated between brands, consumers, objects, and digital environments open innumerable new opportunities to study the behavior and actual intention of purchase of consumers. Literature has, to the best of the author's knowledge, just started to look towards the supply chain applications, where Blockchain could bring new solutions to problems that have not been successfully solved with current technology.

8. Limitations and implications for future research

Due to the initial stages of the Blockchain technology in mainstream applications, there are 3 factors that could affect the model evaluated in this study. First, the acquired knowledge about its usability, second the trust of the market towards it, and third the level of technical knowledge required to understand its advantages. These factors make the study overly sensitive to the level of knowledge of the subjects that took part in the survey, and, thus, the aftermath of the model for the Intention of purchase could be influenced by the novelty of the topic by itself. As Blockchain technology develops and extends to more mainstream areas, the mass market will learn about it. Future research could benefit from a better-informed market and more knowledgeable consumer about Blockchain and NFTs.

Another limitation of the study was its implementation in a cross-sectional structure which, together with the previously mention limitation, will only represent a static image of the market during the time of the study. Future research could be developed in a longitudinal structure by other scholars, where the weights of the items in this study may display differently.

Finally, the idea of Non-Fungible Tokens applied to the physical world has not been extensively explored. Existing literature focusses on the digital world and the metaverse, and most of the applications are designed for digital arts, digital products, and digital ownerships. Communicating the idea of the use of a digital application such as an NFT to certificate a physical product proves to be a challenge in the initial test survey.

The present study hopes to bring further understanding of the Blockchain technology in the fight of counterfeiting, and it is within the hopes of the author to widen the scope of the digital applications studied. While the digital world expands and develops, countless applications could be explored to solve current problems in the physical world, and profitable opportunities can be created to complement each other. Where other studies focus on the separation between the physical and the digital, the real benefit will come from their integration and mutual interface.

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10. Annexes

Item	Scale
Gender	Multiple selection
Male	
Female	
Non-binary	
Prefer not to say	
Age	Multiple selection
18-30	
31-40	
41-50	
51-60	
> 60	
Education	Multiple selection
Primary education	
Secondary education	
BSc Degree	
MSc Degree	
PhD	
Employment	Multiple selection
Full time	
Part time	
Unemployed	
Student	
Prefer not to say	
Internet usage frequency	Multiple selection
N/A	
More than 4h a day	
Between 2h and 4h a day	
Between 4h and 8h a day	
Less than 2h a day	
Are you familiar with NFTs or Blockchain?	Yes
	No
Have you ever heard of Non-Fungible Tokens (NFTs)?	Yes
	No
Do you know that NFTs prevent risks of counterfeiting?	Yes
	No
Do you know that NFTs record the production of a product and track all transactions?	Yes
	No
Do you know that an NFT can provide previous information about the corresponding digital asset to consumers?	Yes
	No
Would you be inclined to pay an extra price for a product certified by a Non-Fungible Token, compared to the same product, without any endorsement of its originality?	Yes
	No

By buying products endorsed by Non-Fungible Tokens (NFTs) as a method of authenticity certification I would feel	1-7 (Likert-type scale)
Bad (1)– good (7)	
Displeased (1)–pleased (7)	
Compared with other methods of product certification, such as QR codes, stickers, and paper certificates. I think that buying products certified by NFTs is:	1-7 (Likert-type scale)
Foolish (1)–wise (7)	
Harmful (1)–beneficial (7)	
Regarding NFTS certifications, in comparison to other methods available (QR codes, stickers and paper certificates):	1-7 (Likert-type scale)
N/A	
1. Products certificated by NFTs will likely be more appealing	
2. Products certificated by NFTs will likely be more expensive	
3. Products certificated by NFTs will likely be of known origin	
4. Products certificated by NFTs will likely be safer to rely on its authenticity	
5. Products certificated by NFTs will likely be of more satisfying quality	
6. Products certificated by NFTs will likely be authentic which means it has not been tampered with in any way and it is what it says it is	
7. Products certificated by NFTs will likely have higher production standards	
I would be inclined to buy products with NFT certifications because:	1-7 (Likert-type scale)
1. My family and friends approve it	
2. The tech community is in favor of it	
3. The media (Social media, TV, Radio) are in favor of it	
4. People important to me or whom I admire buy/prefer it	
5. The marketplaces where the products are sold are in favor of it	
In regard to obtaining information about the product, such as certification and transaction records with the NFT and the blockchain functionality:	1-7 (Likert-type scale)
1. It will be simple to obtain the information	
2. I will be confident about the information contained within the blockchain records	
3. I will be able to find all the product-related information without the help of others	
4. It will be easy to understand the information contained in the records	
5. I will be confident that I will find the additional information	
6. I will be able to understand all the product-related information without the help of others	
When I buy a product, searching for information about the store or marketplace where is being sold, is something that:	1-7 (Likert-type scale)
1. I do it automatically	
2. I do it without consciously considering*	
3. I start doing before I realize I am doing it	
4. I do it without thinking	
When I buy a product, looking for indications or proofs of its originality is something that:	1-7 (Likert-type scale)
1. I do it automatically	

2. I do it without consciously considering it	
3. I start doing it before I realize I am doing it	
4. I do it without thinking	
Certification - When I buy a product, checking the authenticity methods that are displayed (such as Stickers, QR Codes and Paper Certificates) is something that:	1-7 (Likert-type scale)
1. I do it automatically	
2. I do it without consciously considering it*	
3. I start doing it before I realize I am doing it	
4. I do it without thinking	
1. I trust: That the NFT-certificated product can be tracked back to the actual factory	1-7 (Likert-type scale)
2. I trust: The information provided about the production process and origin of the NFT-certificated product	
3. I trust: That the product certified by NFT is authentic, which means it has not been tampered with in any way and is what it says it is	
When NFT certifications becomes available:	1-7 (Likert-type scale)
1. I intend to buy it	
2. I will look for it	
3. It will be important to me to buy it	