

Research on the NFT digital collection in China: risks, measures, and potential development directions

Jiaqi Yan¹, Haiting Han²

¹ National Research University Higher School of Economics, Moscow, Russia

² Center for Blockchain and Electronic Markets, University of Copenhagen, Copenhagen, Denmark

Abstract: Since 2021, non-fungible tokens (NFT) have witnessed explosive growth, gradually becoming one of the hottest investment barometers in the market worldwide. In China, the digital collections of NFTs have great potential to impact the market. This current study is the first to explore the development of NFT digital collections in China from various aspects. The study reveals that the technological logic underlying NFT digital collections in China is similar to those overseas. However, digital collections of NFTs in China emphasize the content value of their digital assets, while NFTs focus on their financial value overseas; moreover, overseas NFTs are cast on the public blockchain, using virtual currencies for anonymous transactions, but digital collections of NFTs are cast on the consortium blockchain, using RMB real-name transactions in China; In addition, the risks that digital collections of NFTs are confronted with in China mainly include four aspects: technical risks, legal risks, financial security risks, and regulatory challenges and risks. It is worth noting that the Chinese government plays a core position in governing these risks. Furthermore, a multi-subjective governance pattern can better reduce/avoid the risk that digital collections of NFTs face, so as to achieve their sustainable development. The Metaverse may be one of the potential developmental directions for NFTs, thus the current study provides several novel insights for follow-up studies concerning NFTs.

Keywords: NFTs; digital collections, risks, potential development directions, Metaverse; China.

1. Introduction

This paper introduces the non-fungible tokens (NFT) technology and its development in China especially studies the difference between NFT's technical path in China and foreign countries. Different from the foreign blockchain deployed on public networks, in China is now more common in the form of "alliance chains". Although in China, the government has not promulgated blockchain-related laws, the control of blockchain technology development and publicity is relatively strict, despite this, a great number of enterprises, such as Tencent, Alibaba, and Netease, have created their own NFT trading platforms and launched various digital collections of NFTs. This phenomenon has attracted a considerable number of Chinese scholars' and experts' attention to studying NFTs. They have actively discussed the concept of NFT—in a nutshell, an NFT is a unique digital certificate registered on the blockchain, which has the characteristics of uniqueness, indivisibility, traceability, and verifiability [1,2,3]. NFTs can furthermore be understood as digital rights certificates for virtual assets or physical assets [4,5]. NFTs can further be mapped or linked to the assets and thus record the relevant content rights of the assets, as well as historical transactional flow information [6].

So far, the NFT has been applied in several fields in China, mainly including museums, arts, and video games. However, it is worth noting that in 2021, most platforms in China used the term “digital

collection” to replace NFTs in their promotion and dissemination in order to weaken the monetary attribute of NFTs and thus avoid any suspicion of speculation [7]. Since then, NFTs have officially entered the Chinese market as "digital collections". Digital collections related to NFTs are called digital collections of NFTs or simply digital collections in the Chinese context. Although NFTs have great potential to impact the market in China, the application of NFT technology is still in its infancy. Moreover, in China, digital collections of NFTs as an emerging sector require further exploration. Therefore, this study aims to: (1) explore the technological logic underlying digital collections of NFTs in China; (2) discuss the risks presented by the application of NFTs in China; (3) provide certain measures for governing/reducing these risks in China; (4) to predict the future developmental direction of digital collections of NFTs in China.

2. Blockchain technology, NFTs, and digital collections

This section discusses the underlying technological logic of digital collections of NFTs in China. This current study thereby reveals that blockchain technology is the underlying technology of NFTs. Moreover, NFT protocol standards mainly include ERC-20, ERC-721, ERC-998, and ERC-1155. In addition, digital collections of NFTs are explained based on five aspects. Ultimately, this current study found that the underlying technological logic of digital collections of NFTs in China is similar to those overseas.

2.1 Blockchain technology: the underlying technology of NFTs

The way the data is structured on the blockchain is that it is divided into a block header and a block body. Different blocks are further connected by the hash value of the previous block header in order to form a chain structure, with the Merkle root field being used between the block header and the block body [8]. Taking Ethereum as an example, the data stored in its block header mainly includes the hash value of the parent block header, the hash value of the Merkle tree root node related to the current block transaction, the block difficulty value, the miner’s address, block height, Gas upper limit, Gas usage, a timestamp, the Nonce value, etc. [9]. The data stored in the block body includes the transaction record table and the uncle (or Ommmer) blocks, in which the NFT transaction record is stored in the data record table of the block body which has been packaged by miners [10,11]. The data packaged into the block that has been already confirmed on the blockchain cannot be tampered with and will be permanently stored on the chain. After the informational data on an NFT is confirmed on the chain, it can no longer be modified. When miners or super nodes use a consensus algorithm to complete block generation, they will broadcast this to the entire network through P2P protocol. After each node receives confirmation of this broadcast information, it will update the information accordingly. In doing so, this mechanism has realized decentralized distributed records, ensuring that malicious nodes cannot tamper with information through consensus algorithms.

2.2. NFT protocol standards: ERC-20, ERC-721, ERC-998, ERC-1155

An NFT is essentially a smart contract based on the Ethereum cryptocurrency, and its architecture corresponds to three of the Ethereum protocol standards. Through smart contracts, Ethereum defines four forms of tokens [12]. In addition to the homogenized fungible tokens represented by ERC20, there is also ERC721 (NFT, non-homogeneous tokens), ERC998 (CNFT, non-homogeneous tokens that can be combined), and ERC1155 (a collection that accommodates and manages various types of tokens).

More specifically, ERC-20 is a homogeneous token, with all of the token units being of equal and divisible value, compatible with Ethereum wallets and wallets that support Ethereum [13]. ERC-721 is a non-fungible token, with each transaction containing only one item, and two transactions being required to purchase two items [14]. ERC-1155 is a collection that accommodates and manages various types of certificates/tokens, with items stored in a centralized smart contract. Any item token can be combined and packaged into a "token package" with an independent ID. One transaction can send multiple commodities to the designated party, which improves the transaction efficiency and reduces transaction costs [15,16,17]. Lastly, ERC-998 is a composable non-fungible token CNFT. A CNFT of ERC-998 can contain multiple items in the form of ERC-721 and ERC-20 and exist in a certain hierarchical structure. Transferring CNFT is to transfer the entire hierarchical structure and ownership of the CNFT [18]. In order to further understand NFT protocol standards, a comparison between them is presented in Table 1.

Table 1. Standard comparison of NFTs

	ERC721 (non-fungible currency)	ERC1155(semi-fungible currency)	ERC998 (Composable non-fungible currencies)
Features	Each token represents asset ownership; Indivisible	Integrate different tokens in batches for conversion	Integrate the first two tokens in batches, inseparable
Advantages	Most common	Bulk transfer possible	Bulk transfer possible
Disadvantage	A contract can only issue one asset	Information missing, Reduce the network decentralization	Pending inspection
Application scenarios	Collectibles/Arts, Securities, etc.	Collectibles, Games, Virtual Worlds, etc.	Collectibles, Games, Properties, etc.
Representative project	NFT Worlds, BAYC, Cryptokitties, Hashmasks	OpenSea, Shared Storefront, Rarible	

NFTs are deployed on the blockchain through standard contracts such as smart contracts using the ERC-721 and ERC-1155 protocols. Specifically, a smart contract is a piece of executable code deployed on the blockchain, and the ERC-721 standard is applicable to any non-homogeneous digital content. Meanwhile, the ERC-1155 is used more in games to identify a type of props, since they trigger an automatic execution through a specific mechanism that once uploaded cannot be modified. Regarding the smart contract transaction triggering and execution mechanism, the transaction is a bridge connecting the external world to the internal state of Ethereum, so Ethereum is also a state machine for transactions. After the deployment of an NFT smart contract is completed, the RPC interface is called upon externally to access the Ethereum main network, then miners package the transaction, and the EVM (Ethereum Virtual Machine) finds the corresponding smart contract and executes the corresponding contract function according to the external input parameters. After the execution is completed, the status is updated on the chain [19]. Generally, the client uploads the blockchain code to the server, and the code processing according to the smart contract protocol, is a simple process as the blow mentioned. Figure 1.

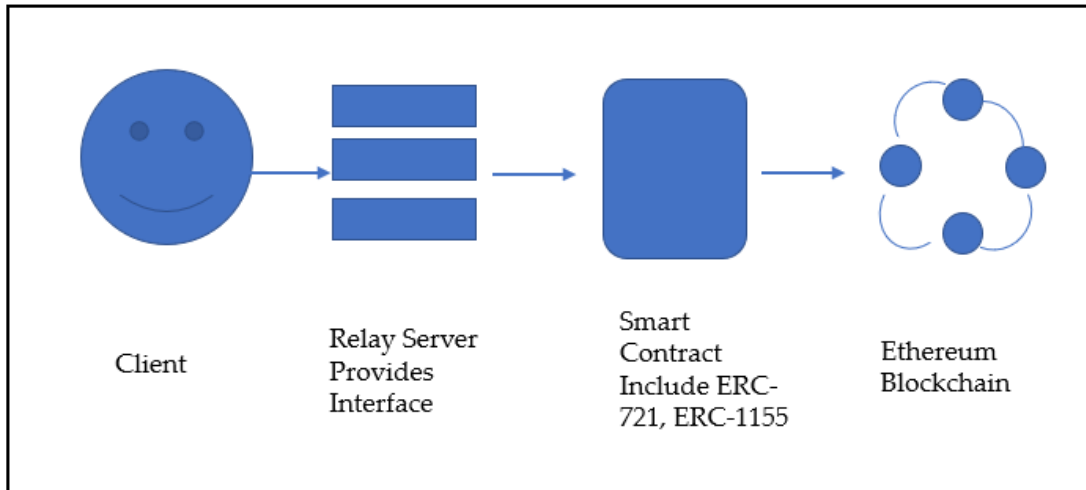


Figure 1: Smart contract interaction model in the Ethereum network

The Ethereum relay acts as a bridge connecting the traditional server side to the Ethereum blockchain in the service cluster. This relay is responsible for the realization of related functions on the public chain, including the majority of the functions of the current Ethereum DApp. The client uploads the code and the Ethereum network will compile the code, once successfully compiled it will execute the code and deploy it on the Ethereum network. To have a clear understanding, the current study presents Ethereum smart contract execution process [20] in Figure 2.

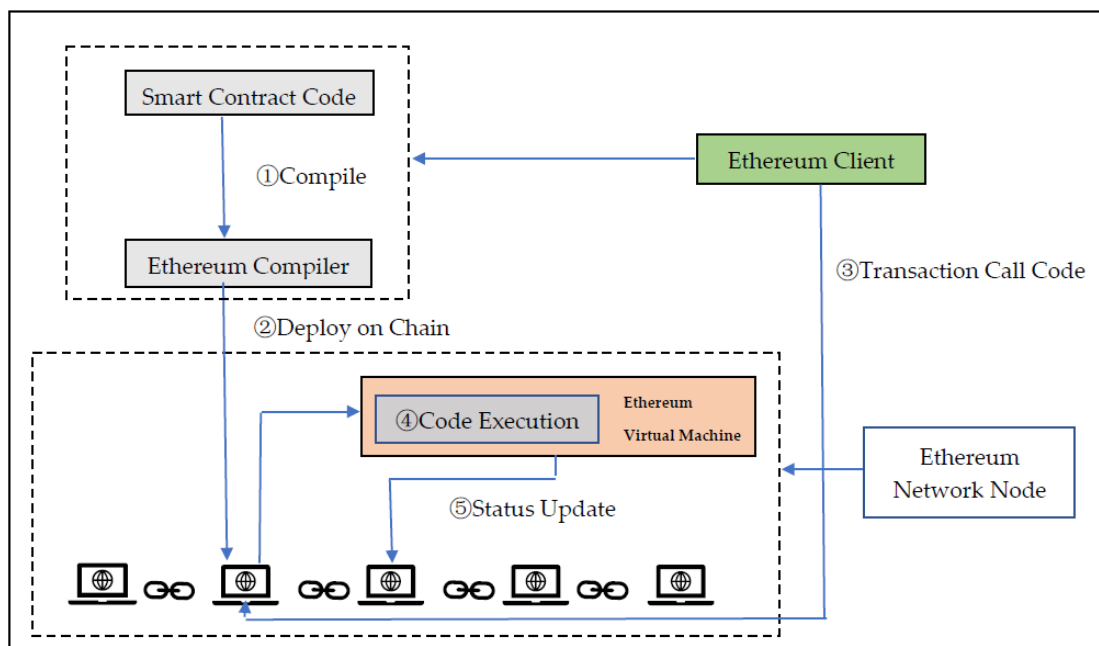


Figure 2. Ethereum smart contract execution process

2.3 NFT Digital collections in China

Expressions of digital collections

Blockchain-based digital collections generally meet the following requirements: first, the digital certificate of the blockchain digital collection has a unique digital asset ID that is inseparable; second, digital assets possess metadata, with this metadata able to be placed on the chain, while some of the

data can be placed off the chain, such as pictures, music, videos, 3D models and other different forms of digital media. Third, the ownership of digital certificates is uniquely confirmed via ID, and this ID can be transferred to different accounts to realize the transfer of non-homogeneous digital certificates. Usually, the metadata does not change with the transfer of assets and includes the following contents: the creator's own information; the time stamp of the digital collection certification; the digital certificate content that the digital collection itself refers to (that is, the URL information of the core media file); and the signature data of the issuing and authenticating party of the collection. With this metadata information, the displaying party of the digital collection can display the digital certificate of the corresponding digital collection in a personalized manner according to this information, to better reflect its value and charm [21].

Interface for digital collections

The interface of the digital collection includes the following three parts: (1) the query interface: including the query of the quantity of the digital collection, the metadata query of the digital collection, the owner of the digital collection, and the authorization query of the digital collection; (2) the distribution interface: including the distribution of digital collections; and (3) the circulation interface: including the transfer of digital collections and the authorization of digital collections (optional).

Significantly, there are currently no standards for digital collections in China, meaning the relevant standards need to be formulated. This would include the development of technical standards based on digital collections, clarifying the definition, functions, and technical requirements of digital collections, etc., to facilitate the transfer of digital rights of digital collections between different blockchain platforms; developing application standards based on digital collections, clarifying digital collections business participation roles, business processes, etc., to assist with the replication and promotion of digital collections in various application scenarios; to develop safety application guidance standards based on digital collections, to clarify the security and compliance requirements that digital collections should meet in their application, and to ensure the safe business development of digital collections.

Common operational semantics

Combined with the interface definition and the expression of digital collections, the common operation semantics of digital collections encompasses three aspects. First of all, there are the smart contracts that contain the specific data structures and interface implementations for digital collections, no matter how complex the specific implementation is, at the interface level, and ultimately need to incorporate three types of interfaces: issuance, transfer, and query. At the data level, at least the core informational data such as the metadata description, asset symbol, and digital ID certificate must be provided. Secondly, the digital credential table that carries the user account side—regardless of the specific implementation—will at least contain a list of the digital credentials held by the account, and this list will at least include the digital credential and the URL information of the metadata. This URL information will be combined with the smart contract, metadata description, further personalized analysis of specific media information, and other forms of metadata information. Finally, external entities outside the chain, including institutions, individual users, and regulators, disseminate the list of the digital certificates of digital collections corresponding to transaction operations through the specific interfaces and data incorporated by smart contracts, to complete the overall operational semantic realization of the digital collections, and to finally realize the digital collection. This includes the underlying business logic of the collection, distribution, transfer, and query of such data.

Application link

Different digital collection applications have different application links. Here, we take digital collections as an example to analyse in detail the role and manifestation of digital collections in each business link. First, there is the creation and distribution of digital collections, where the creator and issuer collect the original media information of the digital collection, generate the metadata and a unique digital certificate ID, and sign the corresponding data with their own private key to generate a signed transaction, and discloses the public key's information. In order to endorse the issuance authorization, the entire issuance process needs to be executed in the form of on-chain transactions. After the transaction is broadcast, it is executed in different blockchain nodes, and finally, a consensus is reached on the chain. When the transaction is successfully chained, the digital collection of the product is issued successfully. Currently, the default digital collection holder is the issuer themselves. Looking at the circulation of digital collections when digital certificates are issued, they will generally be sold, whether through auction or in other forms. The key initiates a signature transaction to transfer the ownership of the digital collection to the new holder, although this transaction also requires a consensus on the chain, with the final success of the chain being marked as the successful transfer of the digital collection asset.

The lifecycle

Digital collections in different businesses have different lifecycles. The lifecycle includes the following stages (see Figure 3)

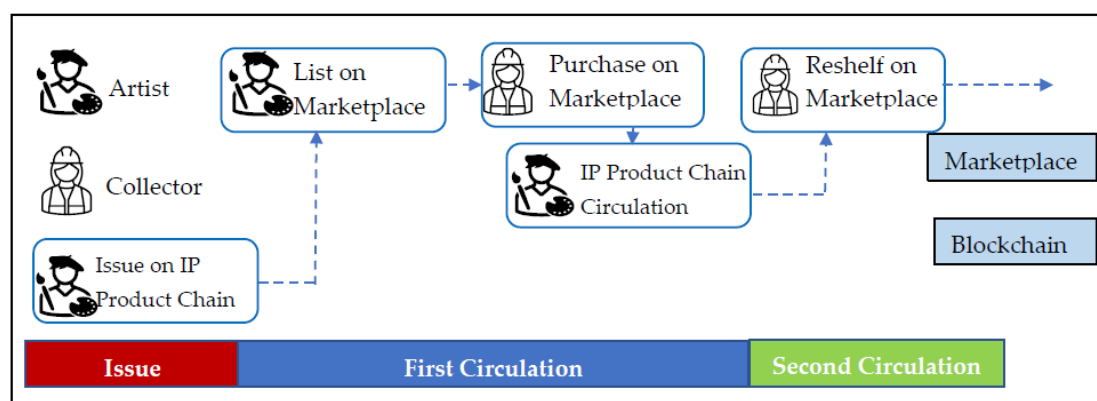


Figure.3. The lifecycle of digital collections of NFTs

The core lifecycle of digital collections encompasses three stages. The first stage is the issuance stage, which is mainly completed by the issuer by casting a new digital collection. The core elements of this stage include the issuer's signature, the unique digital collection's digital certificate ID, the metadata information, etc. Next, the second stage is the first circulation; generally, the circulation of this stage is different from the subsequent secondary circulation in business, as it will place greater emphasis on the first sale of digital collections. The third stage is the secondary circulation of digital collections; generally speaking, this secondary circulation takes place between the collectors of digital collections, and the specific price is usually agreed upon through transaction matching. From a technical point of view, there is no fundamental difference between the first transfer and the second transfer regarding the transfer of ownership of digital collections.

3. The differences between digital collections of NFTs in China and overseas

In fact, China's NFT digital collection market and overseas NFT market have evolved into two

industrial ecosystems. One remarkable characteristic is that digital collections emphasize the content value of digital assets in China, while NFTs focus on their financial value overseas [22, 23]. More specifically, there are several essential differences in the application of NFTs in China and overseas. At the technical level, overseas NFTs are cast on the public blockchain with the characteristics of decentralization, such as ETH, NEO, and QTUM, using virtual currencies for anonymous transactions [24]; However, digital collections of NFTs are cast on the consortium blockchain, relying on cross-chain interoperability technology to achieve an open ecosystem and using RMB real-name transactions in China [25]. Moreover, China's encrypted digital warrant trading platform has certain access standards, with access to the consortium blockchain and the release of encrypted digital products being regulated by the platform. Since the access of the consortium blockchain requires systematic authentication, its decentralization is not as significant as that of the blockchain [22], although it helps to carry out supervision amidst the current rapid development of blockchain technology in China.

From the perspective of industrial chain layout, the underlying infrastructure of overseas blockchains is well-furnished, and there are seldom technical and qualification barriers to the issuance and trading of NFT products [26]. Therefore, in the production process, the copyright owner of an NFT is generally the product issuer, which demonstrates an obvious “Matthew’s effect” in the circulation process [27], while the trading volume of the secondary market is concentrated on the OpenSea platform [28, 29]. However, there are restrictions on the distribution and circulation of digital collections in China, so there is a separation of roles among the copyright owner, product publisher, and transaction circulation platform of digital collections.

As mentioned above, it can be discerned that there have been obvious differences in the technical applications of digital collections and the blockchain in China and overseas, but this does not affect the developmental prospects of digital collections and blockchains in China. Compared to overseas public blockchains, the consortium blockchain is more conducive to supervision and the healthy development of blockchain-related industries in China during the current, initial stage [30]. Moreover, in China, digital collections mainly focus on the “collection” aspect, emphasizing the value of physical or digital assets attached to that collection, while the trading and circulation of NFTs are limited, so as to avoid the developmental direction of tokenization. Although this differs from the monetary aspect of overseas NFTs, it still has great developmental potential and is more suitable for China's developmental conditions. Furthermore, China’s digital collections weaken the transactional attributes of NFTs, and can thus be understood as a one-time digital cultural consumer product, one which is essentially the same as the cultural and creative peripherals [31]. At present, most distribution platforms in China have temporarily eliminated or curtailed the secondary transaction function so as to prevent the financialization of digital collections and to avoid the malicious hype of digital collections in the secondary trading market, which is also for compliance considerations. Therefore, it can be found that the Chinese and overseas NFT markets cannot be interconnected.

4. The risks that digital collections of NFTs are confronted with in China

Digital collections, as part of emerging technology, are confronted with various challenges and risks in China. Technical risks, such as the risk of data loss, hacker attacks, and theft, have become increasingly important, while legal risks such as the infringement of intellectual property rights and the violation of data and privacy rights have attracted greater attention. In addition, the risks of financial security

mainly include money laundering, excessive hype, and illegal fund-raising. Regulatory challenges and risks are also big issues that digital collections face.

4.1 Technical risks

NFTs are typically composed of two components in terms of their technical structure: (1) the smart contract stored on the chain (ERC-721, ERC-1155, and ERC-998 standard specifications); and (2) the digital artwork itself [31]. Whether an NFT exists based on a smart contract URL pointing to it or as a standalone piece directly on the chain is essentially a question of cost. In terms of cost, URLs are currently the most cost-effective option, albeit with loopholes. Currently, the main mode of access to artworks is the use of URLs (web addresses), rather than the direct uploading of digital works. For this technical setup, the following risks exist.

Inaccessibility: risk of data loss

If the NFT platform's servers go down, or if the platform's nodes go down, the digital collection content will be inaccessible and as a result, files may be exfiltrated. For example, users of NFT platforms such as the artists Grimes, DeadMau5, and Steve Aoki, who have all used IPFS storage, have had instances where an NFT has failed to load. In this type of storage, the digital asset to which the URL refers may cease to exist if the distributed storage protocol of that webpage is inaccessible, if the centralized server hosting the metadata ceases to operate, ceases to be accessible, or if the data is deleted or lost. Of course, in a distributed storage system (e.g., IPFS, Interstellar File System), the metadata pointed to by the NFT can theoretically be broken down into smaller chunks of unit data, and each node can provide storage services for this data [33]. At one point in Ether, 89% of the smart contract code had security vulnerabilities or hazards, a huge risk factor for various smart contract-based applications [34]. Due to certain characteristics marking the development of China's blockchain industry, there are several other aspects of technical NFT security that require special attention. For example, foreign countries generally use public chains where transactions are anonymous and decentralized with no entry barriers and equal status of users in transactions; while China uses consortium blockchain, where platforms have certain entry conditions and participants have a clear and realistic identity. For example, "eclipse attacks" have been a problem in blockchain security that has not yet been completely solved [35]. Theoretically, the fewer the participating nodes, the more vulnerable they are to an eclipse attack [36]. In the development of the blockchain in China, due to the policy implications, coalition chains will increasingly occupy an important position, yet due to their relatively few participating nodes, the risk of eclipse attacks will also be more challenging to prevent. Therefore, such risks need to be taken into account in terms of technical security when generating and transferring non-homogeneous passwords based on federated chains.

Risk of hacker attacks and theft

In the technical NFT structure, all operations involved in a smart contract are executed through a single line of code, and if the code is not perfect, it can easily be exploited by hackers to attack NFT accounts [37]. For example, there have also been instances where fraudulent activity was engaged in order to induce users to authorize a smart contract, with the hackers then stealing all of the authorized assets from the user's wallet through the smart contract [38]. In recent years, the NFT market has also seen frequent asset thefts, mainly due to the significant increase in the value and liquidity of NFT assets [39]. Hackers can transfer NFTs to be cashed out after getting a hold of the victim's private key. Although blockchain accounts are theoretically immutable, smart contracts are more vulnerable to theft and forgery than one might think, and because NFT transactions can be lucrative, hackers have the incentive to attack even further. Although the digital signature technology used in the blockchain

ensures that the private key is difficult to crack, hackers can also induce users to reveal information through phishing links. For example, on April 1st, 2022, Jay Chou, a famous singer, posted on social media that his NFT had been stolen and stressed that it was not a joke [40]. Evidence of the ownership and provenance of NFTs relies on each NFT's private key, which can be compromised if the private key holder unwittingly opens phishing software on their computer or if their computer has been maliciously afflicted by a Trojan virus [41]. The person who owns the private key becomes the actual owner of the NFT and can subsequently sell it. With current technology, once NFTs are stolen, the chances of them being recovered are very slim; this is because the blockchain is a decentralized system, and assuming the NFT is transferred to a certain address, the most that can be seen is that address and not the person who used it, so there is no way to recover it.

4.2. Legal risks of digital collections of NFTs in China

Infringement of intellectual property rights

Due to the strong economic incentives of Web 3.0, certain avant-garde digital content creators worldwide have already set up their own personal IP servers through the Discord platform to provide content services directly to their audiences, including NFT-encrypted artwork for sale [42]. In the case of the NFT casting of works of art with a material carrier, the caster needs to digitize the artwork first. During the NFT casting process, the NFT issuer needs to submit the NFT and the NFT's metadata to the NFT trading platform.

It is worth noting that the digitization of NFTs while facilitating copyright owners realizing their relevant copyright and property rights, will further expose them to the risk of infringement of their own rights and may deepen the extent of infringement of their rights [44]. In the casting process, there may be cases where the distributor is not authorized to record the content of image, audio, and video rights owned by others in a smart contract to generate NFTs for distribution, which will infringe on the reproduction, distribution, and information network dissemination rights of others' works [45]; even if the distributor has made partial adaptations and compilations of the works, it may also infringe upon the adaptation rights and compilation rights of others' works [46]. While the blockchain can be used to secure evidence to protect intellectual property rights through its tamper-proof, traceable features, if an IP dispute or infringement situation occurs from the outset, however, the damage may also be amplified through the financial leverage of the blockchain, even producing serious infringement results that are difficult to measure precisely [47].

Violation of data and privacy rights

The process of casting, distributing, selling, and circulating an NFT may pose a threat to the protection of users' data and privacy. For example, there is the legal risk of violating laws and regulations in the handling of the entire data lifecycle, including the collection, storage, transmission, provision to third parties, and cross-border transmission of users' personal information. Moreover, NFT trading platforms will inevitably collect personal information from users, especially when it comes to their real name authentication information, online virtual property information, personal property information such as bank accounts or digital wallet assets, but also online behavioral data, social data, etc. In this collection process, there may be legal risks such as not expressly informing the user, collecting the user's personal information without the user's consent, or collecting the user's personal information beyond the scope of authorization. As well, there may be a legal risk of infringement of users' personal information if it is provided outside of the country or to a third party without consent in the course of the NFT flow [48].

In addition, because the recipient's consent is not required for certain transactions, users may also receive NFTs that they do not want to receive or that is illegal (e.g., containing obscene content).

4.3 Financial security risks

NFT-based products inevitably have financial attributes [49], although this attribute has not been clearly constrained in China. For example, Deng and Li [28] stated that when digital collections are endowed with too much value, they will evolve into financial products and become a carrier of capital flow. Moreover, because it has the characteristics of decentralization, anonymity, and globalization, it is very easy to become a tool for money laundering, financing, and engaging in illegal dark network transactions [40, 50], resulting in economic market chaos and affecting the stability of the Chinese economic market.

The risks of money laundering, excessive hype, and illegal fund-raising

In China, the risk to financial security that digital collections of NFTs are confronted with mainly includes three aspects. The first is the risk of money laundering, with the means for money laundering through the use of virtual assets or other blockchain technologies quietly emerging in the shadow of virtual currency. For example, criminals can buy NFTs with illegal funds and trade them amongst themselves to create sales records on the blockchain; then, when an NFT is sold, criminals will benefit from the latter's clean funds unrelated to the crime. The second is the risk of excessive speculation; Chen [51] indicated that a considerable number of investors do not pay attention to the real value of an NFT, but rather follow market trends to make money quickly, resulting in an excessive deviation of digital collections of NFTs from their real value. For example, the single Dunhuang digital collection series with an issue price of 19.9 yuan was sold for more than 15000 yuan [52]; so far, there is no corresponding system for the economic evaluation of digital collections of NFTs. Related industries select a price merely through market requirements and the speculation of collectors [22,27], which causes the price of digital collections whose cultural value is not high to quickly rise. The last is the risk of illegal fund-raising; the intervention of investment capital has led to the explosive development of the NFT market, which has caused so-called market foam to a certain extent since in the absence of identification and supervision, it is easy to engage in fraud and be afflicted by illegal fund-raising risks.

The NFT digital collection itself harbours multiple value attributes, and mainly exists as a common virtual commodity. However, digital collections of NFTs are limited in their release, and thus are scarce. When they assume the functions of investment and financing instruments, equity certificates, and so on, they may evolve into financial products and become the carriers of speculative profits and capital financing. As such, digital collections of NFTs are very easy to use to induce excessive speculation and may still become the biggest security risk in the financial sector.

Regulatory risks

The policies surrounding NFTs may incur new regulatory risks for the digital collections of NFTs in China. Since 2013, the government has issued a series of policies and regulations on the trade of NFTs. For example, the policies, such as the Notice on Preventing Bitcoin Risks [53], the Announcement on Preventing the Financing Risks of Initial Coin Offerings [54], the Notice on Risk Warning Against Illegal Fundraising in the Name of "Virtual Currency" and "Blockchain" [55], state that regulators proposed avoiding the overhyping of virtual goods such as bitcoin under the guise of "virtual currency", and it is clearly prohibited to issue and finance tokens for the first time, as financial institutions and non-bank payment institutions are not allowed to provide services for business activities related to virtual currency, and criminal activities related to virtual currency should be severely cracked down upon. Furthermore, in 2021, the Central Bank of China and other departments

jointly issued the Notice on Further Preventing and Resolving the Risks of Virtual Currency Trading and Speculation [56], which makes it clear that virtual currency does not have the same legal status as legal tender, and that business activities related to virtual currency are therefore illegal financial activities. These policies have repeatedly highlighted the speculative risk of virtual currencies and their related derivatives. For example, if they are suspected of undermining the financial order and endangering financial security, the relevant departments will investigate and deal with them, and if they constitute a crime, they will also be investigated for criminal responsibility according to the law. Therefore, the resale of digital collections actually greatly increases the risk of speculation, which may affect financial security and stability, and even severely alter the financial order.

In addition, there is no regulatory agency for NFTs, which leads to the dilemma that the rights and obligations of both parties to NFT transactions cannot be clarified and guaranteed in China. At present, most NFTs are digital assets created on the blockchain, but with the development of the market for NFTs, there have been more mappings of physical assets off the chain, and as such regulators may enact corresponding policies for their management. For example, according to the fact that an NFT can measure the value of a subject matter, there may be criminal acts such as money laundering, illegal fund-raising, illegal Internet transactions of contraband, and the use of new technologies and applications to engage in illegal and criminal activities, which presents great difficulties to the government's supervision of NFTs.

5. Measures for governing risks that digital collections of NFTs are confronted with in China

In China, the development of digital collections requires not only science and technology but also the joint efforts of the entire society, the market, regulatory authorities, NFT platforms, and digital art collectors [57]. Although the Chinese government occupies a core position in governing these risks, a multi-subjective governance pattern however can better reduce/avoid the risks that digital collections of NFTs face, so as to achieve their sustainable development. The measures for governing these risks are presented as follows.

5.1. Measures for governing/reducing technological risks

It is necessary to encourage the underlying technological innovation, as the underlying blockchain technology should be developed to support easy cross-chain flows. Due to the nature of blockchain technology, metaverse communities have been developed using a variety of underlying layers which have different systems and user attributes adapted to their technology, and as a result, difficulties have often been encountered when linking together different metaverse communities. Therefore, existing technologies should be adapted with people in mind, and digital assets generated around these users should be easily applied across chains. For example, purchased NFTs should also be able to be used in personal interfaces such as PCs, smartwatches, etc.; NFTs purchased on one trading platform should also be easily transferred to another metaverse platform for re-sale [42], and the base security of an NFT should be supported by means of hard forks. Specifically, a "hard fork" is when a blockchain project is updated or upgraded, and all the participating nodes are asked if they want to participate in the update or upgrade, and those who accept and those who do not enter into two different versions of the system to continue to operate [58].

5.2 Measures for governing/reducing legal risks

This current study has proposed that strengthening the government regulations on digital collections of NFTs and safeguarding the right to authorship could reduce the legal risks. First, strengthening the government regulations on the digital collections of NFTs: based on the infrastructure, identity value network, digital governance architecture, and economic and financial system of the blockchain metaverse, it is clear that the blockchain is the core infrastructure of the metaverse [59]. In this virtual world, NFTs are becoming key intermediaries in building a system of transactions within it [60]. However, the risk management of digital collections of NFTs is a highly specialized task, as not only is there no global precedent for it, but the evolving nature of the technology and industry continues to make the risk uncertainty high [61]. Given the high degree of spontaneity and market dynamism of blockchain technology and industry development (the knowledge community and investment community are particularly active), the risk management of NFT projects can first rely on the blockchain's own governance tools, while the regulatory forces from the government can serve as an active guide for the direction of governance and a strong protector of the risk bottom line, using a "post-regulation" approach to improve the governance system for digital collections of NFTs [62].

Second, safeguarding the right to authorship: under the property law framework of common law countries, NFTs do not possess the legal attribute of being an "object" because they cannot be sold or traded as such [63]. Therefore, new rights should be granted in accordance with the character of NFTs. For example, the authenticity, ownership, and provenance of an NFT are challenging to verify [64]. As well, NFTs are valued for their traceability, rarity, and ownership with the help of underlying blockchain technologies [65]. NFTs revolutionize the distribution and commercial exploitation of works in the Internet environment, with the fundamental paradigm of the web user paying for access to or the use of digital content will be changed, and people will finally be able to become the true owners of a digital good. Blockchain technology can therefore provide strong evidence for artists to claim creatorship and time of creation, which goes some way to preventing intellectual property infringement [66]. Granting artists, the right to recourse is a proper means to protecting the copyright of the author of a work of art. Through the creation and exercise of the right to recourse, the artist can participate in the use of their work, receive a commission on the resale of the artwork, and they can be compensated for the proceeds they cannot obtain from their existing copyright [67]. Thereby, every time the NFT is (re)sold, the original creator could earn a portion of the sale price, which highlights the traceability of NFTs [65].

The financial attribute of digital collections is inevitable. In order to reduce the risk to the financial security of digital collections of NFTs, several measures can be taken in China. For example, Xia et al. [40] highlighted that the essence of excessive financialization of digital collections represents the contradiction between supply and demand. In reality, the reduction of transaction and information flow barriers of digital collections released by high-profile enterprises or artists in the virtual world will aggravate the financialization of this investment. Therefore, it is necessary to tackle the imbalance between supply and demand. Although the centralized structure of the layout of digital collections reduces the content review stage, it amplifies the rarity of digital collections. In addition, the lack of content regulation also fosters a hotbed for speculation, as some investors lack awareness or recognition of the content value of their own commodities. The government should thus expand the access mechanism of institutions, improve the review mechanism of content qualification, and stress value orientation as the main trend guiding the development of digital collections regarding commodity competition.

The second is to make NFT transactions fair and transparent. There are different standards in trading on the secondary market in China, as the platform determines the holding time and trading mechanism. Moreover, the NFT industry lacks self-discipline conventions, moreover, the current trading mechanism of NFTs is still opaque. Some investors even have the pre-emptive right and have obtained information on secondary trading before a sale, amplifying the financial speculation of commodities [7]. Therefore, the current strict regulatory tone is a mechanism intended to reduce speculation expectations. Regarding long-term development, the government should introduce clearer norms for the transaction process. As well, tax issues related to digital collection transactions are also issues that need to be considered at present [68].

The last measure is to solve the problem of value presentation of digital collections. The current NFT industry in China is driven mainly by novelty, with obvious hype characteristics [52]. However, the lack of display and practical application scenarios is one of the reasons why this novel experience cannot be sustained and thus increases investment transactions. In essence, the current construction of the metaverse is not yet mature, and digital collections still exist as independent digital artworks or products, and there is no complete adaptation mechanism for their embeddedness and universality in virtual space [69].

5.3 Measures for governing/reducing regulatory challenges and risks

The iteration of new technologies has also become a major driving force for the renewal and development of legal norms. Specifically, in view of the regulatory risks brought about by NFTs, the relevant rule of law construction needs to focus on the following aspects: first, it is necessary to clarify the legitimacy boundary of NFTs, particularly the legal characterization of NFTs, and then to clarify the regulatory body and its rights and responsibilities. In view of the various risks posed by NFTs in different application scenarios, the existence of a single regulatory agency alone would make it difficult to meet the security needs of NFT transactions. For this, one can learn from the current regulatory structure of digital tokens in China, and thereby undertake comprehensive dynamic supervision with multiple entities such as anti-money laundering regulators, Internet information departments, market regulators, the central bank, and other financial management departments [68]. Meanwhile, the government should strengthen the connection between administrative supervision and criminal law regulation. When relevant activities, such as fraud or pyramid schemes, and illegal fund-raising constitute a crime, they should be transferred to the public security organ in time.

Additionally, it is necessary to improve the governance framework of NFTs. The supervision of NFT projects can first rely on the supervisory means of the trading platform itself, and at the same time, take the government supervision force as the backing to strengthen the prevention and post-event control of risks. The last is to establish the concept of classified supervision. Xie [70] highlighted that to supervise the NFT industry, the legal regulation principles of encouraging innovation, inclusiveness, and prudence should be adopted, and the supervisory methods of cross-departmental coordination of the government and the participation and integration of social forces online and offline. In the digital collection market, the application of NFTs in the industry can be effectively supervised by classification that takes statutory supervision as the main method and is supplemented by industrial self-discipline [68]. Through the regulation and management of targeted self-regulatory organizations, the NFT industry has made the current situation of the application of NFTs in the digital collection market known to relevant government officials; moreover, Zhao [68] stressed that the regulatory authorities can view the NFT-based technology rationally and avoid management chaos for emerging industries through the supervision of the application of NFT technology in the industry.

Significantly, the important guarantee of legal supervision is to clarify the status and authority of NFT regulators and to strengthen the supervision of the entire process underlying NFT artwork creation, storage, and trading in China. However, the application of NFT technology in the digital collection market involves numerous fields, and the division of responsibilities among multiple regulatory bodies is not clear. Therefore, it is necessary to give NFT regulators an independent legal status by establishing independent NFT regulators in the first place [71]. These regulators would mainly be responsible for dictating market access, technical standards, regulatory inspection, enterprise credit information publicity, and other works in the field of NFTs, such as establishing an NFT platform "blacklist" system to supervise virtual currency transactions [70] and to mitigate the regulatory obstacles faced by the development of emerging economies and technologies [71]. In addition to the supervision on behalf of public power, it can also give rise to the autonomy of NFT-related associations. Such blockchain-related industrial organizations will strengthen the industry's self-discipline, which will help to promote the healthy and orderly development of the industry. NFT-related industrial associations supervise and manage the behavior of NFT platforms and operators, and participate in the formulation of the NFT industry's code of conduct and industrial technological application and access standards, so as to realize the controllable protection and circulation of NFT copyrights on the chain; therefore, self-regulatory organizations of the NFT industry should take administrative norms as their guide, promoting their subjective initiative and punishing copyright infringement and money laundering crimes in combination with industry laws [68].

6. The Metaverse: a potential NFT developmental direction in China

Since early 2021, the concept of metaverse to be discussed widely. Until now, there is no standard definition of the metaverse. Generally speaking, the metaverse is constructed with digital technology, mirrored by the real world or beyond the real world, a virtual world that can interact with the real world, and a digital living space with a new social system. Such as, with the help of VR glasses, people can personally experience the virtual space that is a metaverse. It is more like the concretization of concepts mixed with new technologies such as augmented reality (XR), blockchain, cloud computing, digital twins, and artificial intelligence.

In China, many scholars and practitioners consider that with the continuous maturity of NFT technology and the deepening of landing scenarios, they will become important factors to construct and achieving the infrastructure of the Metaverse. To a large extent, the Metaverse will represent a potential developmental direction for NFTs.

First, the NFT is an important infrastructure of the Metaverse, and it can solve the problem of identity authentication and rights confirmation in the Metaverse. Specifically, the blockchain is the underlying infrastructure of the metaverse, and will be used to develop an infrastructure that breaks the original separation between identity and data, and thus create a new economic system through smart contracts [26]. NFTs based on blockchain technology can map virtual objects, ensuring digital ownership and verifiability. It can also effectively authenticate and confirm the rights of each commodity in the Metaverse, with each commodity having a unique value and corresponding price. The original assets in the Metaverse will mainly be carried via NFT.

Second, NFTs can be used to realize value transmission between the Metaverses. The Metaverse is hyperlinked global database of evidence, and unlike the prototype of the Metaverse represented by

virtual world games, the future “meta-universe” will be cross-platform in nature and completely user-created [51]. As one of the core infrastructures of the metauniverse, NFTs have the ability to hyperlink global evidence. After NFT confirmation, assets can differ between the metaverses and different application scenarios, rather than be limited to a specific application scenario. Moreover, NFTs represents an interface to the Metaverse and can become a bridge connecting the real world and the Metaverse. As well, NFTs are a mature Defi blockchain ecosystem, which can provide a set of efficient financial systems for the metauniverse.

7. Discussion and conclusion

This current study explored the status and development of digital collections of NFTs in China based on five aspects. In China, digital collections of NFTs are mainly issued based on the consortium blockchain, so the public-private co-governance model is more feasible. In view of the current legal gap in the field of NFT supervision, the state can promote the relevant legislative process and the release of national standards and industry standards and provide clear compliance guidance for enterprise entities. Although various legal risks that NFTs may lead to having become the proverbial "sword of Damocles" hanging over the whole industry, it is undeniable that NFTs are still a new technology with great potential, having bright developmental prospects in many fields, such as promoting the development of the game industry, promoting the prosperity of virtual activities, protecting digital collections, and even enlightening the metauniverse. However, if the development of NFTs were to be made sustainable, this requires compliant industrial operations and mature regulatory mechanisms to prevent the abuse of the technology and to finally become a tool for violations of law and crime. Only NFT projects can be built on a secure blockchain, follow the legal and compliant issuance and trading mechanism, and not speculate on their purpose, but rather to actually serve in the trading of digital products as required by the scene, and only then can we truly build a healthy and sound NFT trading market. In addition, to a large extent, the Metaverse will be the potential developmental direction of NFTs. NFT can thus become a bridge connecting the real world to the Metaverse.

All this still has a long way to go, and it is still worth looking forward to where NFTs will further develop and to what extent their intrinsic value can be tapped and utilized in the future. Finally, the sustainable development of digital collections must be able to truly give rise to the technical advantages of blockchain, realize the automatic tracking and tracing of transactional information, and enable transactions to be carried out on a unified blockchain platform.

The current study has some limitations. Significantly, the study is an interpretive one, thus empirical data and a field survey should be incorporated for further studies. Another traditional limitation is that the study was conducted in the Chinese context, so the results may not be possible to generalize to other countries.

In China, the regulatory attitude towards virtual currency is very strict. In the future, there may be regulatory interventions in the casting, issuance, sales, circulation, and other links among digital collections. Therefore, determining how to devise a plan to open up the secondary market while curbing speculation requires further study. Additionally, there are still several problems in the storage of NFTs, and most NFT trading markets have not been completely decentralized. Although the NFT itself is stored on the chain, large files cannot be stored on it. Therefore, the NFT's pictures, videos, and

other files are still stored off the chain, and only the hash value data of these files are stored in the NFT's token metadata. This presents a great hidden danger for NFT holders. Therefore, decentralized storage has become a research direction for follow-up researchers.

References

- [1] Valeonti, F.; Bikakis, A., Terras, M., Speed, C., Hudson-Smith, A., Chalkias, K.: Crypto collectibles, museum funding and OpenGLAM: challenges, opportunities, and the potential of Non-Fungible Tokens (NFTs). *Applied Sciences*. 2021, 11(21), 9931.
- [2] Wilson, K. B., Karg, A., Ghaderi, H.: Prospecting non-fungible tokens in the digital economy: Stakeholders and ecosystem, risk and opportunity. *Business Horizons*. 2020, 1-14.
- [3] Guadamuz, A.: The treachery of images: non-fungible tokens and copyright. *Journal Of Intellectual Property Law and Practice*, 2021, 16(12), 1367-1385.
- [4] Dowling, M.: Is non-fungible token pricing driven by cryptocurrencies? *Finance Research Letters*. 2022, 44, 102097.
- [5] Guo, Q. Z.: NFT and its future. *Journalism Lover*. 2021, (11), 36-40.
- [6] Chohan, Usman W.: "Non-fungible tokens: Blockchains, scarcity, and value." *Critical Blockchain Research Initiative (CBRI) Working Papers* (2021).
- [7] Analysis and summary of China's digital collection (NFT) market in 2021, http://science.china.com.cn/2022-01/26/content_41863401.htm, last accessed on 2022/02/01.
- [8] Nakamoto, S.: Bitcoin: A Peer-to-Peer Electronic Cash System, <https://bitcoin.org/bitcoin.pdf>, last accessed on 2022/02/03.
- [9] Vitalik Buterin 2014, Ethereum: A Next-Generation Smart Contract and Decentralized Application Platform, <https://ethereum.org/en/whitepaper/>, last accessed on 2022/02/08.
- [10] Ethereum. Intro to Ethereum, <https://ethereum.org/en/developers/docs/intro-to-ethereum/>, last accessed on 2022/02/15.
- [11] EIP-190: EIP-190: Ethereum Smart Contract Packaging Standard, <https://eips.ethereum.org/EIPS/eip-190>, last accessed on 2022/03/05.
- [12] Frankenfield, J.; Rasure, E. Smart Contracts Definition, <https://www.investopedia.com/terms/s/smart-contracts.asp>, last accessed on 2022/03/05.
- [13] EIP-20: EIP-20: Token Standard, <https://eips.ethereum.org/EIPS/eip-20>, last accessed on 2022/03/05.
- [14] EIP-721: EIP-721: Non-Fungible Token Standard, <https://eips.ethereum.org/EIPS/eip-721> last accessed on 2022/03/05.
- [15] EIP-1155: ERC-1155 Multi Token Standard, <https://eips.ethereum.org/EIPS/eip-1155>, last accessed on 2022/03/05.
- [16] Enjin ERC-1155: Next-Generation Smart Contract, <https://enjin.io/about/erc-1155>, last accessed on 2022/03/06.
- [17] Ethereum. Gas and Fees, <https://ethereum.org/en/developers/docs/gas/>, last accessed on 2022/03/10.
- [18] EIP-998: ERC-998 Composable Non-Fungible Token Standard, <https://eips.ethereum.org/EIPS/eip-998>, last accessed on 2022/04/06.
- [19] Ante, L., 2021. The non-fungible token (NFT) market and its relationship with Bitcoin and Ethereum, available At SSRN 3861106.
- [20] Trusted Blockchain Initiatives. Research Report on digital collections based on blockchain, <https://www.jinse.com/blockchain/1179162.html>, last accessed on 2022/04/06.
- [21] Leech, O.: What Are NFTs and How Do They Work?, <https://www.coindesk.com/what-are-nfts>, last accessed on 2022/04/20.

- [22] Analysis on the current situation and development of China's NFT industry, <https://zhuanlan.zhihu.com/p/517546722>, last accessed on 2022/05/20.
- [23] Pinto-Gutiérrez, C., Gaitán, S., Jaramillo, D., Velasquez, S.: The NFT Hype: What Draws Attention to Non-Fungible Tokens?. *Mathematics*. 2022, 10(3), 335.
- [24] Ante, L.: The non-fungible token (NFT) market and its relationship with Bitcoin and Ethereum. *FinTech*. 2022, 1(3), 216-224. <http://dx.doi.org/10.2139/ssrn.3861106>
- [25] Jiang, Z. F., Peng, Z.B.: Supervision logic in the development of Encryption Digital Art Industry--Research on the rapid dissemination and industry impact based on NFT art. *Academic Forum*. 2021, (04),122-132. doi:10.16524/j.45-1002.2021.04.012.
- [26] Blockchain transactions, Non-fungible token (NFT) and intellectual property, http://www.ipforefront.com/m_article_show.asp?id=1074&BigClass=%E4%B8%93%E6%A0%8F, last accessed on 2022/05/25.
- [27] NFT of Metaverse series: China's digital collection industry is expected to move towards standardization and differentiation, <http://finance.sina.com.cn/blockchain/roll/2022-06-24/doc-imizirav0303739.shtml>, last accessed on 2022/06/19.
- [28] Deng, J. P., Li, J.B.: The right certificate of Digital Art -- the value source, right dilemma and Countermeasures of NFT. *Exploration and Free Views*. 2022, (06),87-95+178.
- [29] White, B., Mahanti, A., Passi, K.: Characterizing the OpenSea NFT Marketplace. 2022. 1-13.
- [30] Jie, X. F., Xu, D.H.: NFT art ecological chain expansion and digital governance: from the perspective of participatory Art. *Nanjing Journal of Social Sciences*. 2022, (06),154-163.
- [31] NFT industry analysis of blockchain: virtual world commodity circulation mechanism behind Digital Collections, <https://baijiahao.baidu.com/s?id=1721709604531290854&wfr=spider&for=pc>, last accessed on 2022/02/03.
- [32] Zhang, Y.: Research on the Current Situation of NFT Based on Blockchain Technology. *Digital Communication World*, 2022, (05), 149-151.
- [33] Wei, S.J., Lü, W.L., Li, S.S.: Overview on Typical Security Problems in Public Blockchain Applications. *Journal of Software*, 2022, 33(1):324-355.
- [34] Lin, S.Y., Zhang, L., Liu, D.S.: Survey of Application Research Based on Blockchain-smart-contract, *Application Research of Computers*, 2021, 38(09):2570-2581.
- [35] Si, X.M., Xu, M.X., Yuan, C.: Survey on Security of Blockchain, *Journal of Cryptologic Research*, 2018, 5(5), 458-469.
- [36] Li, F.; Li, Z.R.; Zhao, H. Research on the progress in cross-chain technology of blockchains. *Journal of Software*, 2019, 30(6):1649-1660.
- [37] Qin, R.; Li, J.J. et al.: NFT: blockchain-based non-fungible token and applications, *Chinese Journal of Intelligent Science and Technology*, 2021, 3(02):234-242.
- [38] Liu, Y.S., Xia, Q., Li, Z. et al.: Research on secure data sharing system based on blockchain[J]. *Big Data Research*, 2020, 6(5): 92-105.
- [39] Chevet S.: Blockchain Technology and Non-Fungible Tokens: Reshaping Value Chains in Creative Industries (May 10, 2018), available at SSRN: <https://ssrn.com/abstract=3212662> or <http://dx.doi.org/10.2139/ssrn.3212662>
- [40] Xia, Y., Huang, H., Bai, Y.L., He, Y., Pan, Y. X.: Research and suggestions on NFT's money laundering risk from the perspective of anti-money laundering. *Times Finance*. 2022, (05),93-95.
- [41] Hu, T.R., Li, Z.C.: Contractual Security and Privacy Security of Smart Contract: a System Mapping Study, 2021, 44(12):2485-2514.

- [42] Wang, C., Cai W.: Digital economics in metaverse: state-of-the-art, characteristics, and vision, *Big Data Research*, 2022, 8(03):140-150. 10
- [43] NFT flow patterns and risks, <https://mp.weixin.qq.com/s/OctJMSDjpCk-emiSe788AA> , last accessed on 2022/06/09.
- [44] Su, Y.: The Legal Nature and Risk Governance of NFT. *Oriental Law*, 2022, (2), 58-68.
- [45] The Copyright Law of the People's Republic of China, Article 10(5)(6)(12).
- [46] The Copyright Law of the People's Republic of China, Article 10(14)(16).
- [47] Tao, Q.: On the Legal Implications of Non-Homogenous Tokenization Transactions of Digital Works, 2022, (2), 58-68.
- [48] Wang, X.M., Liu, D.L.: A comprehensive insight into NFT and its legal risks and compliance., https://www.sohu.com/a/528143897_100138309, last accessed on 2022/06/09.
- [49] Bsteh, S., Vermeylen, F.: From Painting to Pixel: Understanding NFT Artworks, https://www.researchgate.net/publication/351346278_From_Painting_to_Pixel_Understanding_NFT_artworks, last accessed on 2022/03/15.
- [50] NFTs – the new art of Money Laundering?, <https://www.idnow.io/blog/nft-non-fungible-tokens-new-art-money-laundering/>, last accessed on 2022/03/12.
- [51] Chen, J.D.: Legal imagination beyond the meta universe: digital identity, NFT and pluralistic regulation. *Research on Rule of Law*. 2022, (03),43-54.
- [52] Digital collections are popular! Second hand can be charged to nearly 100000?, <https://export.shobserver.com/baijiahao/html/497859.html>, last accessed on 2022/06/14.
- [53] National Internet Finance Association of China; Securities Association of China; China Banking Association. Notice on Preventing Bitcoin Risks, http://www.gov.cn/gzdt/2013-12/05/content_2542751.htm, last accessed on 2022/03/01.
- [54] The People's Bank of China, The Cyberspace Administration of China; ...; the China Securities Regulatory Commission and the China Insurance Regulatory Commission. Announcement on Preventing the Financing Risks of Initial Coin Offerings, http://www.gov.cn/xinwen/2017-09/04/content_5222657.htm, last accessed on 2022/04/02.
- [55] People's Bank of China; ...; State Administration of Foreign Exchange. Notice on Further Preventing and Resolving the Risks of Virtual Currency Trading and Speculation, http://www.gov.cn/zhengce/zhengceku/2021-10/08/content_5641404.htm, last accessed on 2022/02/05.
- [56] The China Banking and Insurance Regulatory Commission; ...; The State Administration for Market Regulation. Notice on Risk Warning Against Illegal Fundraising in the Name of “Virtual Currency” and “Blockchain”, <http://www.pbc.gov.cn/rmyh/105208/3609899/index.html>, last accessed on 2021/11/09.
- [57] Zhang, H.B., Zhang, Q.: Science Technology and Law Chinese-English Version. NFT artworks: new forms of digital art and response to copyright rules. 2022, (03),42-50.
- [58] Neha G. Security and Privacy Issues of Blockchain Technology, in Shiho Kim & Ganesh Deka eds., *Advanced Applications of Blockchain Technology*, Springer, 2020, p. 213.
- [59] Li, M., Zhang L., Song, W.P. et al.: Blockchain: core Metaverse infrastructure. *Computer Engineering*, 2022, 48(6): 24-32, 41.
- [60] Lik-Hang L., Tristan B. et al.: All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda, *Journal of Latex Class Files*, 2021, 14(8), 35-36.

- [61] Finzer D.: The non-fungible token bible: everything you need to know about NFTs [EB/OL], <https://opensea.io/blog/guides/non-fungible-tokens/>, last accessed on 2022/06/22.
- [62] Cheng, Y.: Data protection and numeracy regulation in a meta-regulatory model, *Science of Law*, 2019, 37(04), 48-55.
- [63] Joao Marinotti, Tangibility as Technology, 37 *Georgia State University Law Review*, 2021, (37), 716-717.
- [64] Rick Van der Ploeg.: In art we trust. *De Economist*, 2002, 150(4), 333–362.
- [65] Sharma T., Zhou Z.X., Huang Y., Wang Y.: It's A Blessing and A Curse": Unpacking Creators' Practices with Non-Fungible Tokens (NFTs) and Their Communities. arXiv preprint arXiv:2201.13233.
- [66] Birgit C., Ruth B.: Crypto-Pie in the Sky? How Blockchain Technology is Impacting Intellectual Property Law, *Stanford Journal of Blockchain Law & Policy*, 2019, (2), 252-255.
- [67] Zhang, H., Zhang, Q.: NFT Artwork: New Forms of Digital Art and Copyright Rules Response. *Science technology and law (Chinese-English version)*, 2022, (03), 42-50.
- [68] Zhao, L., Shi, J.: Managing the chain by law: technology application and legal supervision of blockchain. *Journal of Law Application*. 2020, (03),33-49.
- [69] Chen, M., Xiao, P.: Technology adoption and responsible innovation of libraries, archives and museums (LAM) in the meta universe era: NFT centered thinking. *Library Development*. 2022, (01),121-126.
- [70] Xie, X.S.: Inclusiveness and prudence: the administrative supervision strategy of new economic formats under the background of the fourth industrial revolution. *Journal of Northwest University (Philosophy and Social Sciences Edition)*. 2019, (03),33-42.
- [71] Li, Y., Wang, D.: Legal response mechanism of personal information security risk under blockchain. *Theory Research*. 2020, (01),75-76.